Original Instructions

OPERATING MANUAL

for

INTELLIGENT LOOP SYSTEM

on the

SUPER TURBO-X 48 Mk III
SUPER TURBO-X 510 Mk III
SUPER TURBO-X 612 Mk III

MANUAL No.: H676SA0090E

Serial No.:

NC unit: MAZATROL PREVIEW

Before using this machine and equipment, fully understand the contents of this manual to ensure proper operation. Should any questions arise, please ask the nearest Mazak service center.

IMPORTANT NOTICE

1. **Be sure to observe the safety precautions described in this manual and the contents of the safety plates on the machine and equipment. Failure may cause serious personal injury or material damage. Please replace any missing safety plates as soon as possible.**
2. **No modifications are to be performed that will affect operation safety. If such modifications are required, please contact the nearest Mazak service center.**
3. **For the purpose of explaining the operation of the machine and equipment, some illustrations may not include safety features such as covers, doors, etc. Before operation, make sure all such items are in place.**
4. **This manual was considered complete and accurate at the time of publication, however, due to our desire to constantly improve the quality and specification of all our products, it is subject to change or modification. If you have any questions, please contact the nearest Mazak service center.**
5. **Always keep this manual near the machinery for immediate use.**
6. **If a new manual is required, please order from the nearest Mazak service center with the manual No. or the machine name, serial No. and manual name.**

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- NOTE -

SAFETY PRECAUTIONS

This manual is prepared only for the function or the device which is specified in the title of this manual. Therefore, you are required to carefully read and understand the operating manual of the machine, especially the section describing safety precautions, before using or operating the function or the device.

1 INTELLIGENT FUNCTIONS

The ST-X Mk III series denotes a new development of the Mk II series with the Intelligent functions added. The Intelligent functions are mainly provided for reducing the setup time as well as detecting, and taking corrective measures against, defect in laser machining.

This manual gives an outline of the Intelligent functions and describes the relevant operating procedures and programming formats.

Table 1-1 Intelligent functions (main functions)

Function	Contents	Reference
Nozzle change function (ANC)	Replaces the nozzle with the specified one by referring to the tool data.	Section 1-2
System of automatically measuring & compensating the focal length of the lens (by blue flame detection)	Detects the focal point by the blue flame sensor.	Chapter 2
Function of automatically detecting contamination on the optical mirror & lens	Detects contamination from changes in the focal length.	Chapter 3
Automatic focusing function (Servo Focus torch)	Automatically determines the lens position.	Chapter 5
Intelligent Monitoring System (IMS)	Reduces the piercing time, and detects defect in machining.	Chapter 6

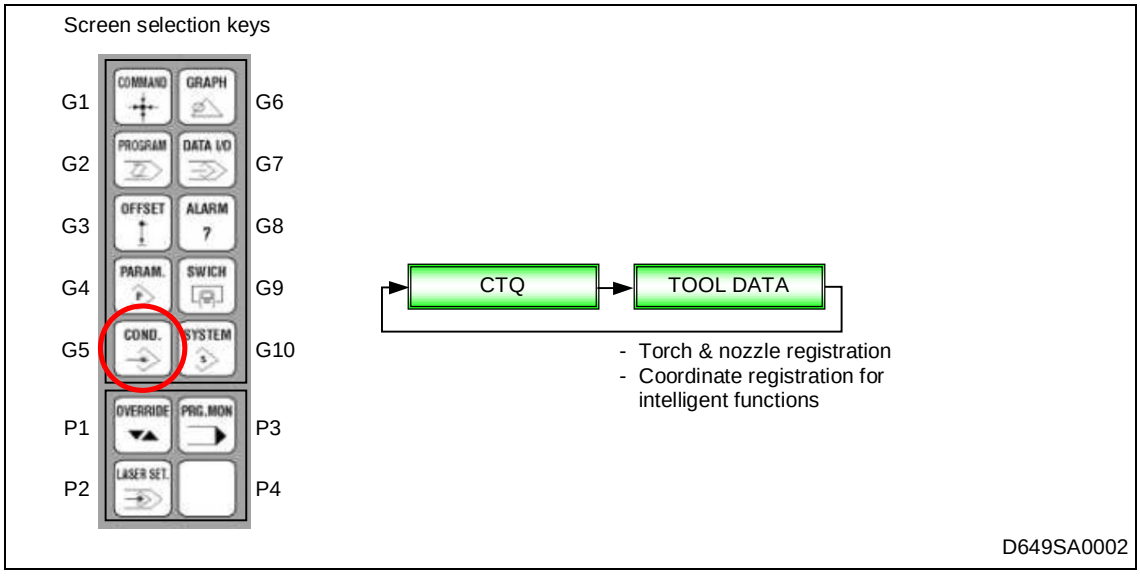
Table 1-2 Intelligent functions (other functions)

Function	Contents	Reference
Tracer calibration	Executes calibration for a non-contact tracing (profiling) unit.	Section 1-3
Function of removing spatters from the nozzle (Nozzle grinding function)	Removes spatters from the nozzle with grinder and brush.	Section 1-4
Function of memorizing automatic focusing function & calibration	Memorizes the focusing function and the calibration.	Section 1-5
Function of specifying a particular tool	Specifies a particular one of multiple nozzles of the same type and size provided in the magazine.	Section 1-6

1-1 Tool Registration

The information on the tools (torches and nozzles) must be registered in the CNC beforehand.

To register tools, press the COND. key on the operation panel and use the **TOOL DATA** screen.



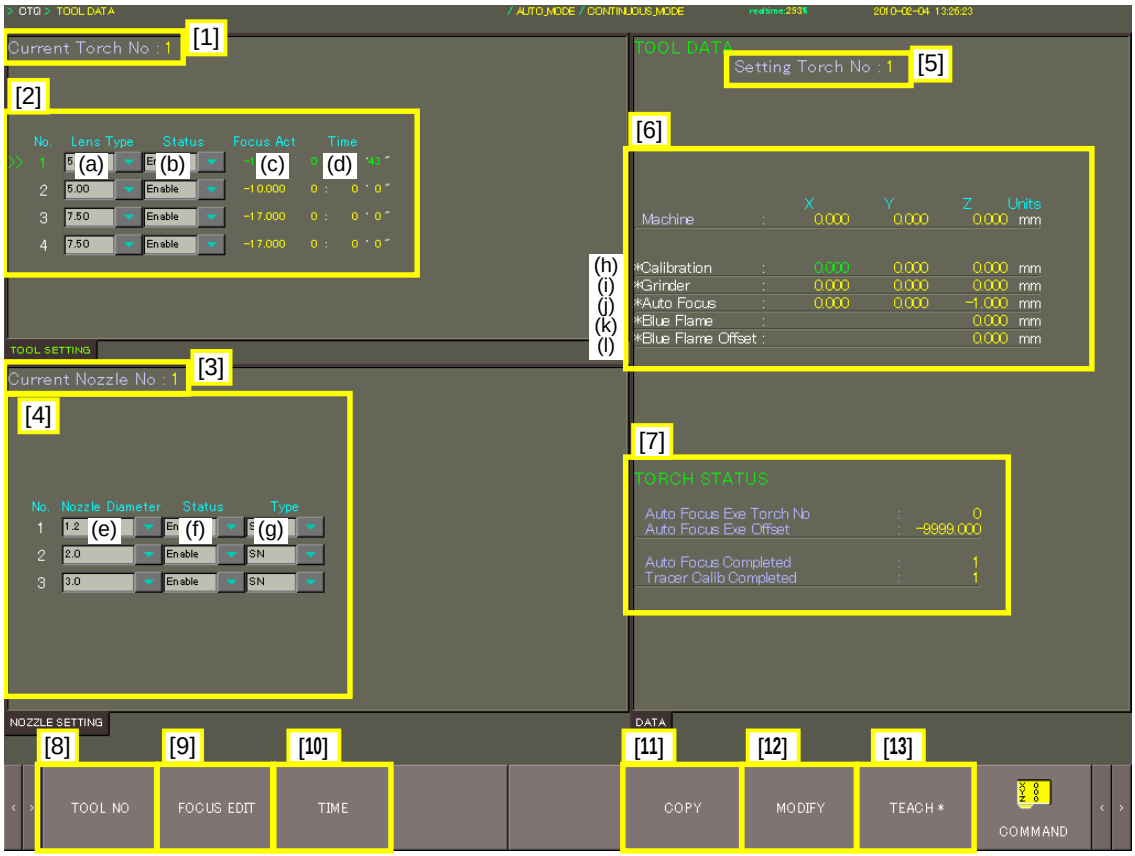
1-1-1 Checking tool data

Check whether the required tools (torches and nozzles) are correctly registered on the **TOOL DATA** screen.

To specify the desired torch and nozzle in the program, use the G22 code.

Note: Unless the torches and nozzles to be specified by G22 are registered, the execution of the G22 command will only result in an alarm being caused.

TOOL DATA screen



D676S0200E

[1] Current torch number

[2] Torch registration
- (a) To select a torch
- (b) To select “Enable”
- (c) To check NF distance (**Note**)
- (d) To check application time

[3] Current nozzle number

[4] Nozzle registration
- (e) To select a nozzle size
- (f) To select “Enable”
- (g) To select a nozzle type

[5] Setting torch number

[6] Setting for Intelligent functions
- (h) Calibration position
- (i) Grinding position
- (j) Automatic focusing position
- (k) Blue flame position
- (l) Blue flame offset

[7] Status indication of the currently selected tool

[8] Use this menu function to correct the number of the current torch or nozzle after manual tool change.

[9] To change NF distance (**Note**)

[10] To clear the tool’s application time

[11] [COPY] menu function
Use this menu function to copy the coordinates registered for another torch for the purpose of setting the items required for intelligent functions.

[12] Coordinate setting

[13] Coordinate teaching

Note: “NF distance” means the distance between the nozzle edge and the focal point of the torch.

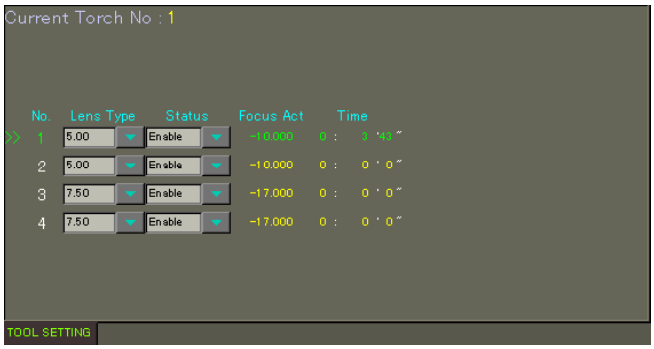
1-1-2 Registering a torch

Follow the procedure below to register the available torches:

(1) Press the COND. key on the operation panel.

➔ The **TOOL DATA** screen appears on the display.

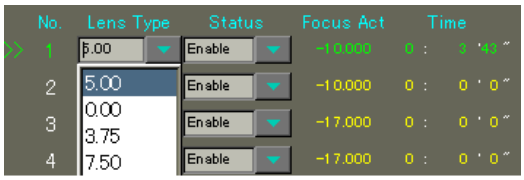
(2) Select the **TOOL SETTING** column.



(3) Press the Tab key to select the **No.** 1.

(4) Press the "↓" key to select the torch type (lens type).

- Alternatively, use the mouse to open the drop-down menu.



- Select "0.00" for a holder which does not contain any torch.

(5) Repeat Steps (3) and (4) to register all tools (torches).

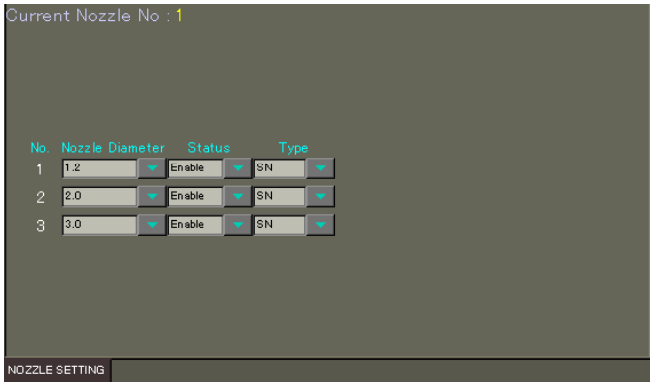
1-1-3 Registering a nozzle

Follow the procedure below to register nozzles currently stored in the nozzle change magazine:

(1) Press the COND. key on the operation panel.

➔ The **TOOL DATA** screen appears on the display.

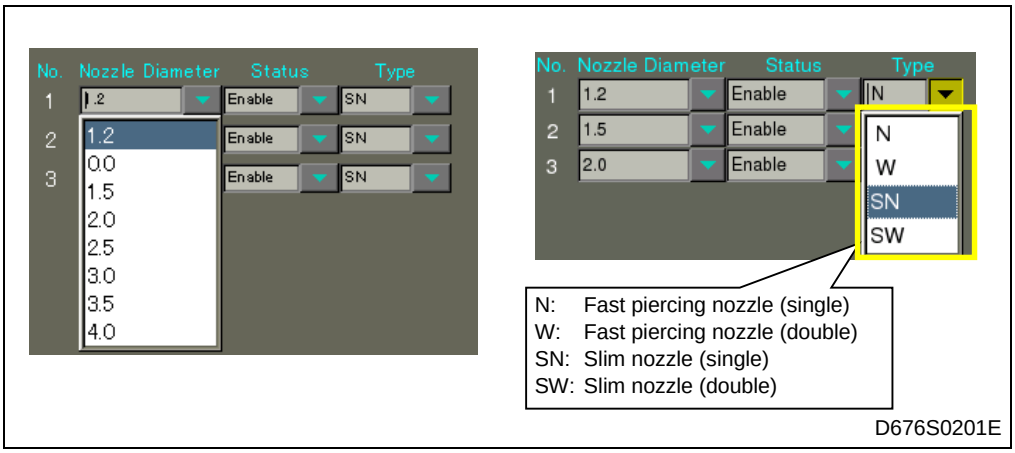
(2) Select the **NOZZLE SETTING** column.



(3) Press the Tab key to select the **No.** 1.

(4) Press the "↓" key to select the nozzle hole diameter and nozzle type.

- Alternatively, use the mouse to open the drop-down menu.



- Select "0.0" for a station which does not contain any nozzle.

(5) Repeat Steps (3) and (4) to register all tools (nozzles).

1-2 Operating Procedure and Programming Method (for ANC)

Use the G22 code to execute a tool command.

In response to a G22 command, the nozzle magazine is indexed to position the required station, which is determined according to the specified nozzle type, in reference to the tool data registered in the CNC.

Other functions related to the Automatic Nozzle Change function, such as defect preventive function, can be executed additionally. Use the parameters concerned to select the functions to be applied.

1-2-1 Operating procedure

(1) Before executing a G22 command (before automatic operation), be sure to check whether the items on the current tool (torch and nozzle) displayed on the **TOOL DATA** screen agree with the actual machine state.
Any tool data discrepancy could cause an alarm. Be sure to check the **TOOL DATA** screen and conduct data correction as required.

Item	Contents
Current Torch No.	Check whether the displayed No. agrees with the currently mounted torch.
Current Nozzle No.	Check whether the displayed No. agrees with the currently mounted nozzle.

Note: The current status of the cutting head can be recognized by the CNC unit from the **Current Torch No.** and **Current Nozzle No.** items.

- Tracer calibration is always executed when nozzle is changed.
- When the nozzle specified with G22 is the same as the currently mounted one, calibration is skipped.
- Focal point offset is executed with reference to the corresponding setting on the **TOOL DATA** screen.

(2) Give a G22 command in an MDI operation program or in a program for automatic operation.

Example: `G22 T7.5 Z3.0 W1 U-2.`

(3) Call up the **COMMAND** screen and open the **INTELLIGENT PARAMETER** window to select the functions to be applied.

(4) Execute the program.

1-2-2 Programming format

G22 **I** (Plate material) **J** (Plate thickness) **T** (Torch type) **Z** (Nozzle size) **W** (Nozzle type) **U** (Focal point offset)

Table 1-3 Programming format of G22

Address	Contents	Unit	Setting range
I	Plate material	—	1: Mild steel 2: Stainless steel 3: Aluminum
J	Plate thickness	mm	0 - 99.999
		in	0 - 9.9999
T	Torch type	in	
Z	Nozzle size	mm	0 - 99
W	Nozzle type	—	0: Fast piercing nozzle (single) 1: Fast piercing nozzle (double) 2: Slim nozzle (single) 3: Slim nozzle (double)
U	Focal point offset amount	mm	–19.0 to 5.0 (dependent on machine specifications)
		in	–0.748 to 0.196 (dependent on machine specifications)
H	Nozzle designation	—	
C	Nozzle grinding function	—	0: Not executed 1: Executed before nozzle change 2: Executed after nozzle change 3: Executed before and after nozzle change
V	Tracer calibration	—	0: Not executed 1: Executed
B (**Note**)	Blue flame	—	0: Not executed 1: Executed
R (**Note**)	Lens contamination detection	—	0: Not executed 1: Executed

Note: Not usable in a machining program. Manually remove the nozzle and set the **Current Nozzle No.** to zero (0) on the **TOOL DATA** screen before executing the function in question.

1-2-3 Command details

Be sure to enter arguments T, Z, W and U (except C) for the use of the Intelligent functions.

G22 **T** (Lens size) **Z** (Nozzle size) **W** (Nozzle type) **U** (Focal point offset) **C** (Nozzle grinding)

Table 1-4 G22 command

Address	Contents	Unit	Setting range	Remarks
T	Torch type	in	Cutting torch 3.75, 5.00, 7.50, 8.50, 8.75	Specify the lens size (in focal length).
Z	Nozzle size	mm	1.0, 1.2, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0	Specify the nozzle size in mm.
W	Nozzle type	—	0: Fast piercing nozzle (single) 1: Fast piercing nozzle (double) 2: Slim nozzle (single) 3: Slim nozzle (double)	Do not fail to specify arguments Z and W by pairs.
U	Focal point offset amount	mm	–19.0 to 5.0 (dependent on machine specs.)	Indispensable for executing the automatic focusing function after changing nozzles.
		in	–0.748 to 0.196 (dependent on machine specs.)	
C	Nozzle grinding function	—	0: Not executed 1: Executed before nozzle change 2: Executed after nozzle change 3: Executed before and after nozzle change	Main use is to clean the nozzle before changing nozzles.

1-2-4 Programming patterns

Enter a G22 block as follows according to the particular use:

No.	Use	Programming method	Remarks
1	Selecting plate material and thickness	G22I_J_	Acceleration/deceleration, tracing gain, and IMS setting are changed accordingly.
2	Changing nozzles only	G22Z_W_	Do not fail to specify W.
3	Changing nozzles and Executing automatic focusing function	G22Z_W_U_	
4	Changing nozzles and Executing automatic focusing function and nozzle grinding function	G22Z_W_U_C_	
5	Returning the nozzle	G22Z0W_	Can be executed without specifying T.

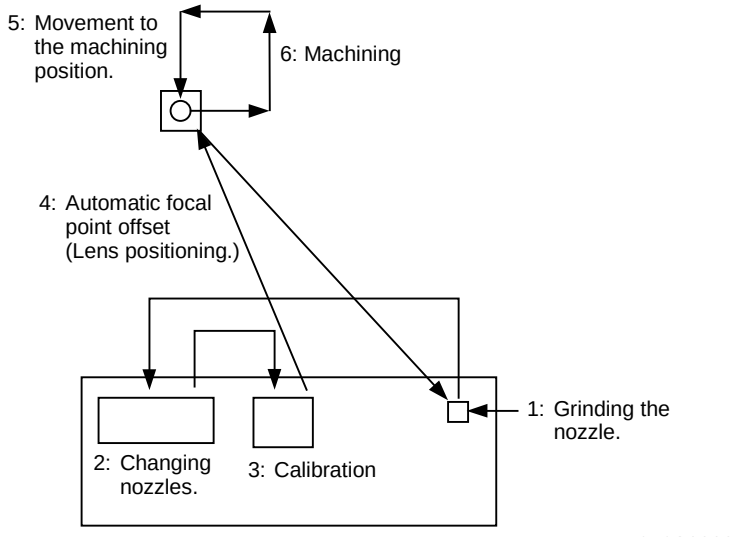
Note: Erroneous programming methods.

The following programming methods are erroneous:

No.	Use	Programming method	Remarks
1	Without arguments Z and W	G22T_	
2	Without argument W	G22T_Z_	

1-2-5 Operation

A nozzle change command with G22 is executed in the following sequence:



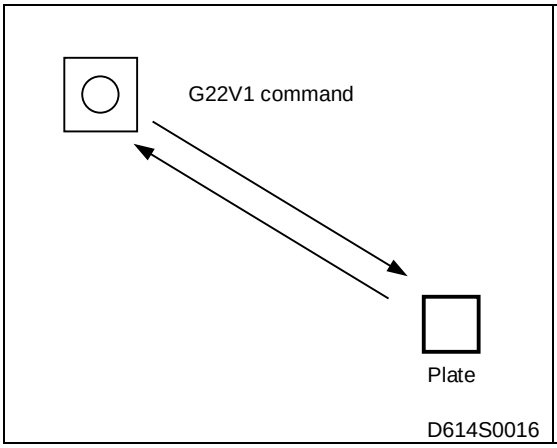
G22T_Z_W_U_C_ is executed in the following sequence.

1: Removing spatters from the nozzle.
2: Changing nozzles.
3: Calibration.
4: Focal point offset.
5: Movement to the machining position.
6: Machining.

1-3 Tracer Calibration Function

1. Function and purpose

The CNC automatically reads the voltage of tracer outputs. In the execution flow of a nozzle change command (with G22) the tracing sensor is calibrated first, and then the output voltage from the tracer is adjusted. Next, the CNC reads the adjusted voltage in the automatic cycle. Consequently, trace control appropriate to individual torches becomes possible.



2. Programming format (for calibration only)

```
G22 V1
```

3. Detailed description

1. This G22 command is to be executed in automatic or MDI operation mode with the head within the effective strokes (in normal machining area).
2. Tracer calibration is automatically carried out in the execution flow of a nozzle change command (G22Z_W_).
3. A calibration error occurs during NC calibration if the voltage for a gap (NW) of 1 mm is abnormal.

4. Related parameters

Table 1-5 Related parameters

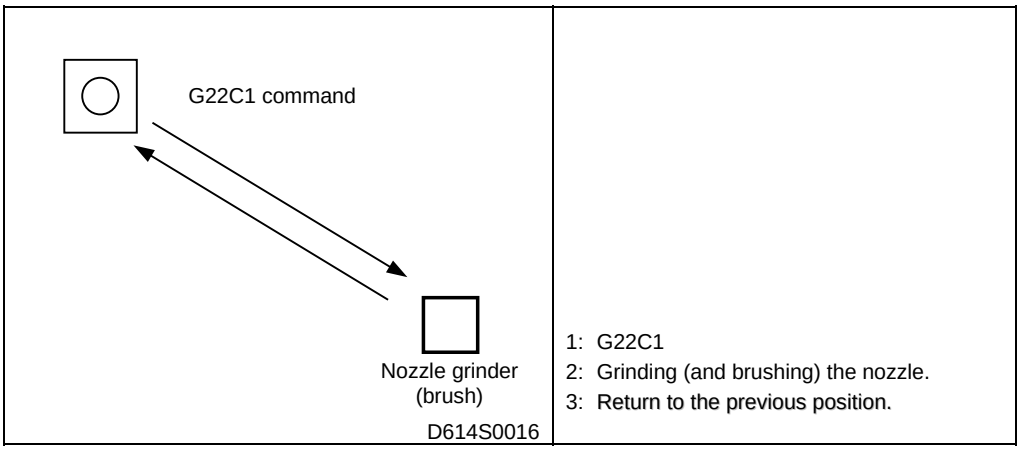
Parameter No.	Contents	Unit	Setting range	Default	
L033	Tracer NC calibration valid/invalid	—	0, 1	1	1: valid 0: invalid

Note: If **L033** is set to “0”, it is necessary to perform manual adjustments using the **TRACE** screen.

1-4 Function of Removing Spatters from the Nozzle

1. Function and purpose

This function is provided to remove spatters from the nozzle. Removal of spatters is automatically carried out in the execution flow of a nozzle change command (with G22) on condition that the function is made valid by the intelligent parameter concerned.



2. Programming format (for grinding and brushing only)

```
G22 C1
```

3. Detailed description

1. This G22 command is to be executed in automatic or MDI operation mode with the head within the effective strokes (in normal machining area).
2. Grinding and brushing is automatically carried out in the execution flow of a nozzle change command (G22Z_W_) on condition that the function is made valid by the intelligent parameter concerned.

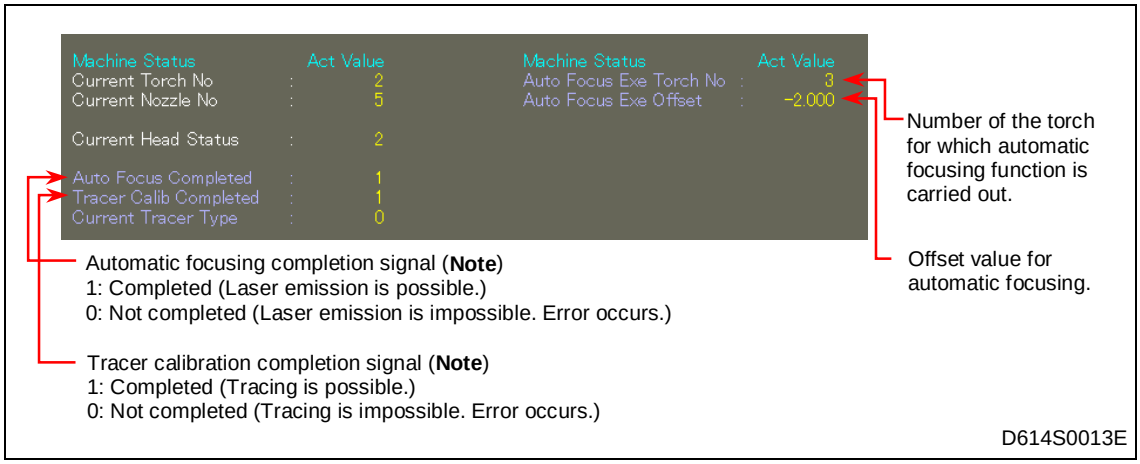
4. Related parameters

Table 1-6 Related parameters

Parameter No.	Contents	Unit	Setting range	Default	
L040	Grinding function valid/invalid	—	0, 1	1	1: valid 0: invalid
L044	Nozzle grinder/brush valid/invalid	—	0, 1	1	1: valid 0: invalid

1-5 Function of Memorizing Automatic Focusing Function and Calibration

When the automatic focusing function or the calibration is executed, the completion of the execution is stored in the NC, and useless repetitions will be skipped for a tool change command which is given for the same type and the same offset amount.
If a torch is manually removed, however, this completion status is cancelled, and the automatic focusing function and the calibration are executed again for any G22 command. This functional design is made for operational safety. Laser beam emission without the automatic focusing function being completed is very dangerous, and laser machining cannot be started under that condition. Nor can tracing occur without the calibration being completed.


Machine Status
Act Value
Current Torch No : 2
Current Nozzle No : 5
Current Head Status : 2
Auto Focus Completed : 1
Tracer Calib Completed : 1
Current Tracer Type : 0
Machine Status
Act Value
Auto Focus Exe Torch No : 3
Auto Focus Exe Offset : -2.000
Number of the torch for which automatic focusing function is carried out.
Offset value for automatic focusing.
Automatic focusing completion signal (Note)
1: Completed (Laser emission is possible.)
0: Not completed (Laser emission is impossible. Error occurs.)
Tracer calibration completion signal (Note)
1: Completed (Tracing is possible.)
0: Not completed (Tracing is impossible. Error occurs.)
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Note: Operating the switch for torch removal causes the signal to be turned to “0”.

1-6 Function of Specifying a Particular Tool

1. Function and purpose

When there are multiple nozzles of the same type provided in the magazine, a particular one can be specified by the serial number within the group of the same type.

2. Programming format

G22 Z (Nozzle size) **W** (Nozzle type) **H** (Nozzle No.)

3. Detailed description

A particular nozzle can be specified by a parameter H (an argument in the G22 block). An example is given below for the selection of the second 1.5-mm nozzle.

```
G22 Z1.5 W0 H02
```

Order No. of the nozzle

4. Restrictions

- If the nozzle specified by an argument H in the G22 block is set to “Disable”, an error occurs without searching for another nozzle of the same type.
- If the argument H is omitted, an automatic tool (nozzle) selection occurs in ascending order of the tool numbers with the “disabled” tools being skipped.

2 SYSTEM OF AUTOMATICALLY MEASURING & COMPENSATING THE FOCAL LENGTH

2-1 Outline

This function automatically detects the focal point of a lens. The focal point detected by this function is used in lens positioning. This function carries out a blue flame detection for the currently mounted torch.

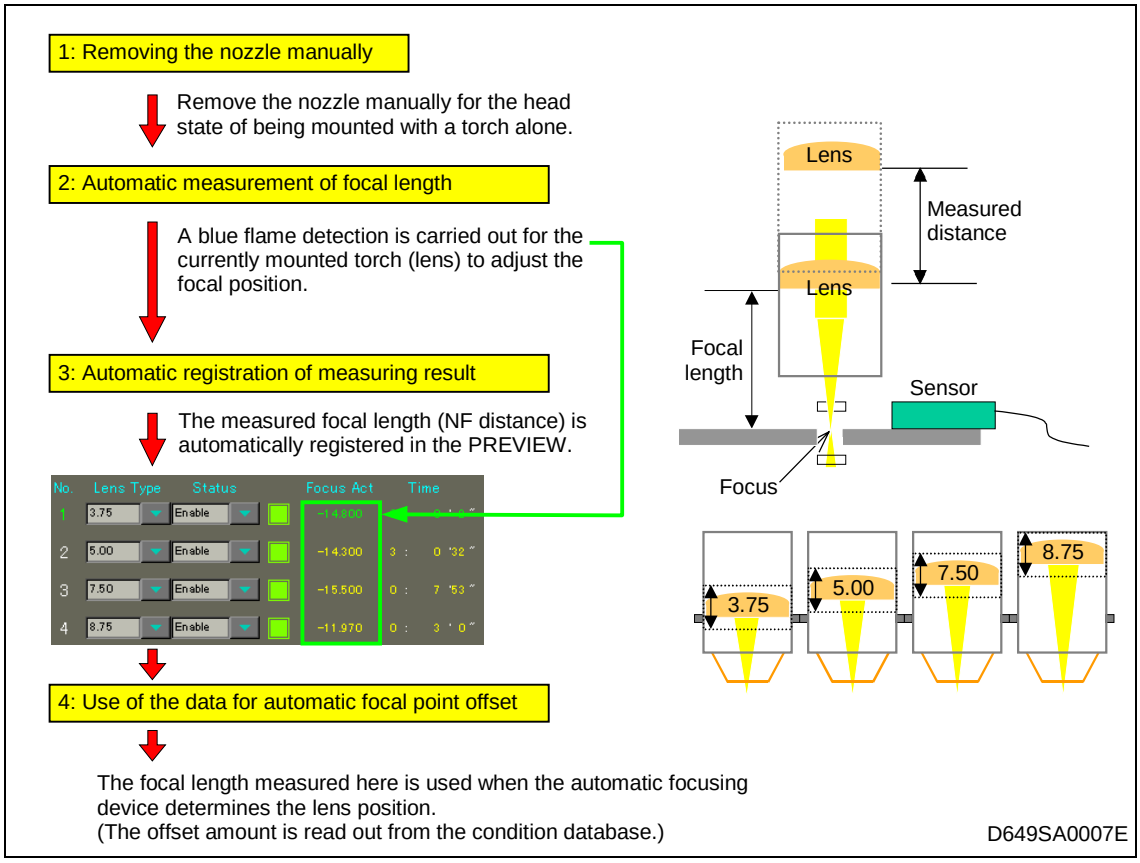

1: Removing the nozzle manually
Remove the nozzle manually for the head state of being mounted with a torch alone.
2: Automatic measurement of focal length
A blue flame detection is carried out for the currently mounted torch (lens) to adjust the focal position.
3: Automatic registration of measuring result
The measured focal length (NF distance) is automatically registered in the PREVIEW.
No. Lens Type Status Focus Act Time
1 3.75 Enable
2 5.00 Enable -14.300
3 7.50 Enable -15.500
4 8.75 Enable -11.970
4: Use of the data for automatic focal point offset
The focal length measured here is used when the automatic focusing device determines the lens position.
(The offset amount is read out from the condition database.)
Lens
Measured distance
Lens
Focal length
Sensor
Focus
3.75
5.00
7.50
8.75
D649SA0007E

Fig. 2-1 Outline of the system of automatically measuring & compensating the focal length

1. Applications

The focal length of the lens is automatically measured by a blue flame detection sensor to significantly shorten the setup time.

2. Specifications

- The measurement is possible only for the torches having the following lenses:

  3.75", 5.0", 7.5", 8.5", and 8.75"

- Measuring accuracy is within ±0.15 mm (0.006 in). (However, the NF distance may change according to the optical conditions or the maximum output.)

- The maximum permissible frequency of measurement per plate is 25 times. Replace the plate with a new one as appropriate (in response to the warning message displayed on the screen, with the program execution being stopped in the feed hold state). After replacement, press the CYCLE START button to resume the automatic operation. Do not press the RESET key to clear the warning message; otherwise the operation cannot normally be resumed any more.

3. Operation

- The focal length is automatically measured by a G22B1 command, the measuring result loaded into the PREVIEW and indicated on the **TOOL DATA** screen.
- One cycle consists of 5 measurements to obtain the optimal focal point that is then displayed on the **TOOL DATA** screen.

4. Restrictions and precautions

- Unless the plate height is correctly adjusted, operational failure or significant measurement error occurs.
- The height of the plate must be adjusted for each torch type.
- Unless the lens is correctly set in a torch, the focal length cannot be measured appropriately. Assemble the parts as specified.

2-2 Operating Instructions

1. Operating procedure

(1) Remove the nozzle from the torch mounted on the cutting head.

(2) Set the **Current Nozzle No.** to zero (0) on the **TOOL DATA** screen.

Note: Do not fail to perform this zero setting after manual removal of the nozzle; otherwise an alarm will occur.

(3) Create a program of the following contents.

- Program creation is to be done for MDI as well as for automatic operation.

Program contents: **`G22 B1`**

(4) Execute the program.

➔ The focal point is automatically detected and the focal length data on the **TOOL DATA** screen is updated accordingly.

(5) Mount the nozzle anew on the torch.

(6) Finally set the **Current Nozzle No.** on the **TOOL DATA** screen in accordance with the currently mounted nozzle.

3 FUNCTION OF AUTOMATICALLY DETECTING CONTAMINATION ON THE OPTICAL MIRROR & LENS

3-1 Outline

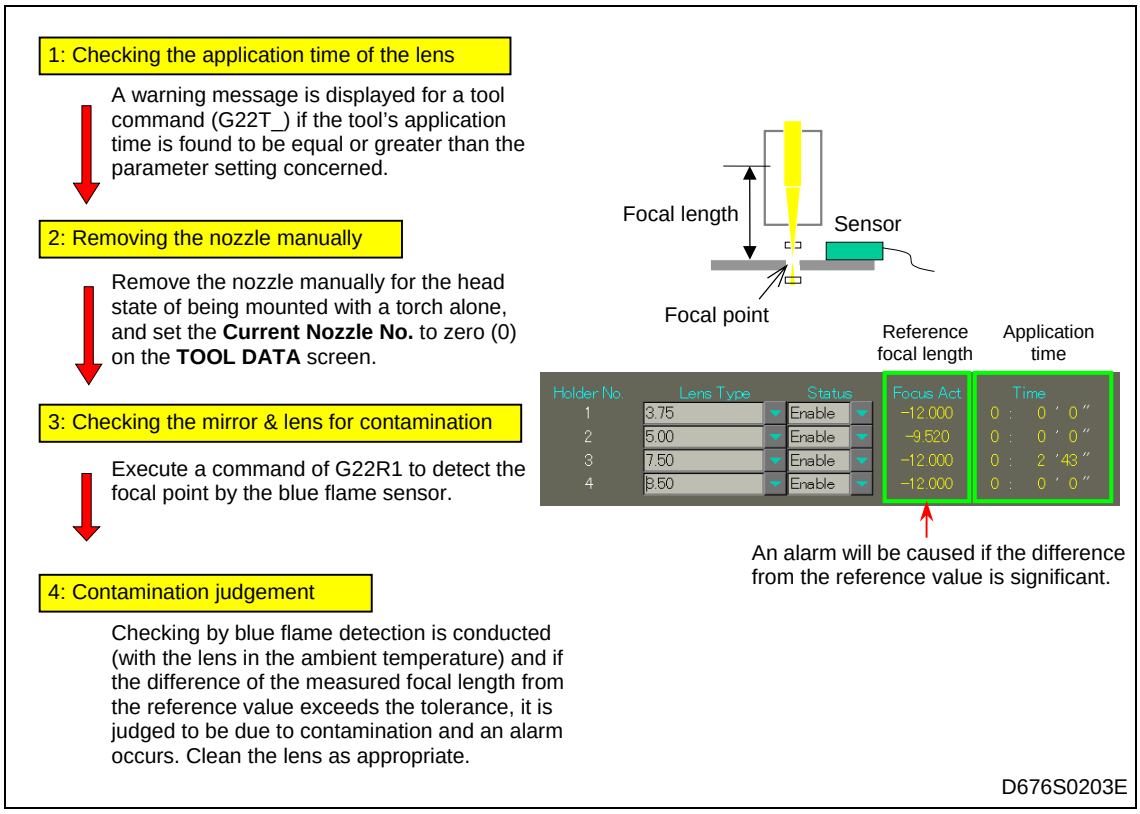

1: Checking the application time of the lens
A warning message is displayed for a tool command (G22T_) if the tool's application time is found to be equal or greater than the parameter setting concerned.
2: Removing the nozzle manually
Remove the nozzle manually for the head state of being mounted with a torch alone, and set the Current Nozzle No. to zero (0) on the TOOL DATA screen.
3: Checking the mirror & lens for contamination
Execute a command of G22R1 to detect the focal point by the blue flame sensor.
4: Contamination judgement
Checking by blue flame detection is conducted (with the lens in the ambient temperature) and if the difference of the measured focal length from the reference value exceeds the tolerance, it is judged to be due to contamination and an alarm occurs. Clean the lens as appropriate.
Focal length
Sensor
Focal point
Reference focal length
Application time
Holder No.
Lens Type
Status
Focus Act
Time
1 3.75 Enable -12.000 0 : 0 ' 0 "
2 5.00 Enable -9.520 0 : 0 ' 0 "
3 7.50 Enable -12.000 0 : 2 '43 "
4 8.50 Enable -12.000 0 : 0 ' 0 "
An alarm will be caused if the difference from the reference value is significant.
D676S0203E

Fig. 3-1 Outline of the function of automatically detecting contamination on the optical mirror & lens

1. Applications

The optical mirror and lens are automatically checked for contamination to prevent machining defects.

2. Specifications

- The contamination detection is possible only for the torches having the following lenses:
  3.75", 5.0", 7.5", 8.5", and 8.75"
- If the difference of the measured focal length from the reference value exceeds the following tolerance, it is judged to be due to contamination and an alarm occurs.
  Contamination detection level: 0.6 mm [0.24"] (Detection level may be changed.)

3. Operation

A warning message is displayed for a tool command (G22T_) if the tool's application time is found to be equal or greater than the parameter setting concerned. In response to the message execute a command of G22R1 for detecting contamination on the lens.

4. Restrictions and precautions

The current focal length of the torch must be set (as the reference) beforehand on the **TOOL DATA** screen. Measure the focal length as required either manually or by executing a command of G22B1 (to activate the "system of automatically measuring & compensating the focal length of the lens").

3-2 Operating Instructions

1. Operating procedure

(1) Check the parameters for setting the contamination detection timing.

1) Call up the **USR PARAMETER** screen.

2) Open the **INTELLIGENT USR** page.

3) Use the "Page ↓" key to display the second page and check the parameters concerned.

Note: Change the initial setting as required. It should be noticed here, however, that an excessively long time interval can deteriorate the preventive effect of the function.

Parameter No.	Contents	Unit	Initial setting	
L086	Time interval for lens contamination detection	s	270000	75 hours

(2) Make this function valid by setting the intelligent user parameter concerned to one (1).

1) Call up the **USR PARAMETER** screen.

2) Open the **INTELLIGENT USR** page.

3) Use the "Page ↓" key to display the second page.

4) Set the **L080 Lens Dirt Detect Valid** parameter to one (1).

➔ The function becomes valid.

Parameter No.	Contents	Unit	Setting range	
L080	Lens contamination detection valid/invalid	—	0, 1	1: valid 0: invalid

(3) Execute the torch change command (G22).

Example: `G22T7.5Z3.0W0U-2.`

➔ The application time of the torch with a 7.5" lens is checked against the parameter setting concerned so as to determine whether to continue automatic operation or to stop it with a warning message.

(4) In case the warning message is displayed, press the RESET key and manually remove the nozzle from the torch mounted on the cutting head.

- Since the program execution is only stopped in the feed hold state, press the CYCLE START button (instead of the RESET key) as required to resume the automatic operation.

(5) Set the **Current Nozzle No.** to zero (0) on the **TOOL DATA** screen.

Note: Do not fail to perform this zero setting after manual removal of the nozzle; otherwise an alarm will occur.

(6) Create a program of the following contents.

- Program creation is to be done for MDI as well as for automatic operation.
  Program contents: **G22 R1**

Note: This command block cannot be used in a machining program since its execution requires the cutting head to be mounted with a torch only.

(7) Execute the program.

➔ The lens is checked for contamination by blue flame detection.

➔ If the execution of the checking program results in an alarm, clean the lens, measure its focal length and register the measuring result on the **TOOL DATA** screen.
When the program is executed to the end without causing an alarm, then the focal length setting on the **TOOL DATA** screen is automatically updated with the measuring result (no focal length measurement is therefore required).

- When the lens cleaning is required, do not fail to reset the cumulative application time of the lens to zero (0).

(8) Mount the nozzle anew on the torch.

(9) Finally set the **Current Nozzle No.** on the **TOOL DATA** screen in accordance with the currently mounted nozzle.

Note: If the lens should be cleaned to no effect, the optical path might be contaminated significantly. Please contact Mazak service center.

- NOTE -

4 ALARM LIST

This chapter enumerates and describes the Intelligent Loop System alarms (programmed in the Intelligent macroprograms).

1. Alarm list

No.	Message	Contents
1202	CURRENT TOOL DATA ERROR	There is an erroneous setting among the tool data items.
1203	CURRENT NOZZLE DATA ERROR	The current nozzle number is not correct.
1206	TRACER CALIBRATION ERROR	The Z-coordinate for tracer calibration is not correct.
1207	TRACER SKIP SIGNAL ERROR	The input signal by touching the plate cannot be received appropriately during tracer calibration.
1208	TRACER VOLTAGE ERROR	The voltage for tracer calibration is not correct.
1209	PARAMETER SETTING ERROR	The parameter for setting the number of tracing voltage values to be detected is not correct.
1211	COMMAND T DATA ERROR	Argument T is not correct.
1212	COMMAND Z DATA ERROR	Argument Z is not correct.
1213	COMMAND W DATA ERROR	Argument W is not correct.
1214	COMMAND J THICKNESS ERROR	Argument J is not correct.
1215	AUTO FOCUS OUT OF RANGE	Argument U for automatic focusing is outside the setting range.
1216	MATERIAL ERROR	Material designation is not adequate.
1217	THICKNESS ERROR	Plate thickness designation is not adequate.
1220	LASER DISCHARGE ON	The given command is not compatible with the lasing condition.
1221	TRACE ON	The given command is not compatible with the tracing condition.
1222	ASSIST GAS ON	The given command is not compatible with the assisting-gas supplying condition.
1223	CLEAN LENS.	Lens contamination has been detected.
1240	NOT CORRECT TOOL	The given command is not compatible with the currently selected tool.
1250	UPPER BLUE FLAME ISN'T DETECTED	The upper side of the blue flame cannot be detected.
1251	LOWER BLUE FLAME ISN'T DETECTED	The lower side of the blue flame cannot be detected.
1252	BLUE FLAME IS NOT DETECTED	The blue flame cannot be correctly detected.
1253	FOCUS IS OUT OF RANGE	The focus obtained by the blue flame detection is outside the allowable range.
1254	AUTO FOCUS DIST. OUT OF RANGE	The reference distance for the automatic focusing function (#998) is outside the setting range.
1255	FOCUS LENGTH IS OUT OF RANGE	The focal length (#999) is outside the setting range.
1280	INTELLIGENT BOX AREA	A command of G22 is given with the cutting head remaining within the special area of the intelligent box.

2. Alarm description

The alarm list is written in the following format:

No.	Message	Clearing procedure
[1]	[2] (, ,)	[3]
Cause	[4]	
Action	[5]	

[1] : Alarm number

[2] : Alarm message

[3] : Clearing procedure

Code	Procedure
A	Power off → Eliminate cause. → Power back on
B	Eliminate cause. → Power off → Power back on
C	Eliminate cause. → Press RESET key.
D	Press RESET key.
E	Press CLEAR key.

Note: "Power off" denotes switching-off of the NC and breaking of main circuit.

[4] : Cause of alarm

[5] : Action to be taken to eliminate the cause

No.	Message	Clearing procedure
1202	CURRENT TOOL DATA ERROR (, ,)	D
Cause	There is an erroneous setting among the tool data items.	
Action	1. Check the current torch No. on the **TOOL DATA** screen to correct the erroneous setting (smaller than zero [0], or larger than the maximum number of available torches [4 and 6 for the standard machine and particularly for HG612, respectively, or 20 for machines with a magazine]). 2. The function for blue flame detection or lens contamination detection requires the nozzle to have been removed from the torch. Remove the nozzle and change on the **TOOL DATA** screen the current nozzle No. to zero [0] and, if required, the current head status to one [1]. 3. The function for workpiece corner detection requires a nozzle to have been mounted on the torch. Mount a nozzle on the torch and change on the **TOOL DATA** screen the current nozzle No. from zero [0] to the appropriate number (not exceeding the maximum permissible number) and, if required, the current head status to two [2].	
1203	CURRENT NOZZLE DATA ERROR (, ,)	D
Cause	The current nozzle number is not correct.	
Action	1. Check the current nozzle No. on the **TOOL DATA** screen to correct the erroneous setting (smaller than zero [0], or larger than the maximum permissible number [10]). 2. The nozzle check function (with a CCD camera) requires a nozzle to have been mounted on the torch. Mount a nozzle on the torch and change on the **TOOL DATA** screen the current nozzle No. from zero [0] to the appropriate number (not exceeding the maximum permissible number).	
1206	TRACER CALIBRATION ERROR (, ,)	D
Cause	The Z-coordinate for tracer calibration is not correct.	
Action	Follow the procedure below to set the Z-coordinate for tracer calibration correctly: (1) Mount the torch and the nozzle on the head. (2) Perform movements on the XY-plane to the calibration position according to the machine type. - Standard machine (with 4 available torches): X = **J340**, Y = **J341**. - Machine with a magazine (for 20 torches): Refer to the **MAGAZINE DATA** screen. - HG612: Refer to the **TOOL DATA** screen. (3) Lower the head on the Z-axis by operating the pulse handle to bring the nozzle into contact with the calibration plate (until **AUTO GAP CONTROL ALARM** is displayed on the screen). (4) Read the Z-coordinate on the screen and set the reading in the following memory cell according to the machine type: - Standard machine (with 4 available torches): **J342** (Z-coordinate for tracer calibration). (In this case, contact Mazak service center before modifying the parameter setting.) - Machine with a magazine (for 20 torches): **Calibration Z** on the **MAGAZINE DATA** screen. - HG612: **Calibration Z** on the **TOOL DATA** screen.	
1207	TRACER SKIP SIGNAL ERROR (, ,)	D
Cause	The input signal by touching the calibration plate has not been received appropriately during tracer calibration.	
Action	Take the following measures: 1. Clean the nozzle end, if contaminated, and execute the calibration anew, 2. Clean the calibration plate, if contaminated, and execute the calibration anew, and/or 3. Correct the nozzle mounting state, if required, and execute the calibration anew. If the above measures should be of no effect, contact Mazak service center.	

No.	Message	Clearing procedure
1208	TRACER VOLTAGE ERROR (, ,)	D
Cause	The voltage for tracer calibration is not correct.	
Action	Take the following measures: 1. Clean the nozzle end, if contaminated, and execute the calibration anew, 2. Clean the calibration plate, if contaminated, and execute the calibration anew, and/or 3. Correct the nozzle mounting state, if required, and execute the calibration anew. If the above measures should be of no effect, contact Mazak service center.	
1209	PARAMETER SETTING ERROR (, ,)	D
Cause	The parameter for setting the number of tracing voltage values to be detected is not correct.	
Action	Set the parameter concerned (**J460**) to 20 or less. Consult Mazak service center as to whether and how to correct the parameter.	
1211	COMMAND T DATA ERROR (, ,)	D
Cause	The argument T in an ATC command block with G22 is not correct.	
Action	1. Correct the erroneous torch number specified as an argument T (smaller than zero [0], or larger than the maximum number of available torches [4 and 6 for the standard machine and particularly for HG612, respectively, or 20 for machines with a magazine]). 2. Correct the erroneous lens size specified as an argument T (smaller than zero [0], or larger than the maximum permissible value [399]).	
1212	COMMAND Z DATA ERROR (, ,)	D
Cause	The argument Z in an ATC command block with G22 is not correct.	
Action	1. Correct the erroneous nozzle number specified as an argument Z (smaller than zero [0], or larger than the maximum permissible number [10]). 2. The torch mounted on the head cannot be returned to the torch holder directly without the nozzle having been removed. Return the nozzle beforehand (as required by G22Z0W0). 3. The tool change command for a laser torch must always be given in a format for mounting both torch and nozzle (G22T_Z_W_); a G22 command with torch designation only (G22T_) is inadmissible. 4. Correct the erroneous nozzle size specified as an argument Z (smaller than zero [0], or larger than the maximum permissible value [9.9]).	
1213	COMMAND W DATA ERROR (, ,)	D
Cause	The argument W in an ATC command block with G22 is not correct. A nozzle change command is given without argument W for specifying the nozzle type (single or double).	
Action	According as the required nozzle is a single or a double one for fast piercing, give a command of the format G22Z_W0 or G22Z_W1. The format for a slim (single or double) nozzle is G22Z_W2 or G22Z_W3. A G22 command with an argument Z only (G22Z_) is not admissible.	
1214	COMMAND J THICKNESS ERROR (, ,)	D
Cause	Argument J (for specifying the plate thickness) in a G22 command is outside the setting range.	
Action	Correct the argument J. Setting range for argument J (plate thickness): $0 < J \leq 99$.	
1215	AUTO FOCUS OUT OF RANGE (, ,)	D
Cause	Argument U (for automatic focusing) in a G22 command is outside the setting range.	
Action	Correct the argument U. Setting range for argument U (for automatic focusing) is as follows: $-14 \leq U \leq 2$ mm, or $-0.551 \leq U \leq 0.078$ in [for a torch without Servo Focus functions], or $-19 \leq U \leq 5$ mm, or $-0.748 \leq U \leq 0.197$ in [for a torch with Servo Focus functions].	

No.	Message	Clearing procedure
1216	MATERIAL ERROR (, ,)	D
Cause	Argument I (for specifying the material) in a G22 command is not adequate.	
Action	The MSCS (Mazak Safe Cut System) is only applicable to stainless steel. To use the MSCS, therefore, enter “I2” in a G22 command (G22I2). (I = 1: Steel, 2: Stainless steel, 3: Aluminum, 4: Bonderized steel, 5: Brass, 0: MSCS not used)	
1217	THICKNESS ERROR (, ,)	D
Cause	Argument J (for specifying the plate thickness) in a G22 command is not adequate.	
Action	1. The MSCS (Mazak Safe Cut System) is only applicable to a plate at least 8 mm or 0.315 in. thick. To use the MSCS, therefore, enter a value equal to, or larger than, the above in a G22 command. 2. Argument J (for specifying the plate thickness) for tapping is outside the setting range. Correct the argument J.	
1220	LASER DISCHARGE ON (, ,)	D
Cause	An ATC command with G22 is given under lasing condition.	
Action	Execute M23 (Lasing OFF) before the ATC command.	
1221	TRACE ON (, ,)	D
Cause	An ATC command with G22 is given under tracing condition.	
Action	Execute M31 (Tracing OFF) before the ATC command.	
1222	ASSIST GAS ON (, ,)	D
Cause	An ATC command with G22 is given under assisting-gas supplying condition.	
Action	Execute M09 (Assisting gas OFF) before the ATC command.	
1223	CLEAN LENS. (, ,)	D
Cause	Lens contamination has been detected by the corresponding detection function.	
Action	Clean the lens, measure its focal length manually and register the measuring result under **Focus Act** on the **TOOL DATA** screen. Executing a command of G22B1 for focal length measurement updates the data item in question automatically.	
1240	NOT CORRECT TOOL (, ,)	D
Cause	It is attempted to execute tracer calibration with a tap unit mounted on the head. Or it is attempted to execute the function for blue flame detection or lens contamination detection with an inadequate torch mounted on the head.	
Action	1. Tracer calibration is not applicable to the tap unit. Do not give a tracer calibration command (G22V1) in a program section for tapping. 2. The function for blue flame detection or lens contamination detection is only applicable to the torch with a lens of the size (in focal length) 3.75", 5", 7.5", 8.25", 8.5", or 8.75". Check the torch registration on the **TOOL DATA** screen.	
1250	UPPER BLUE FLAME ISN’T DETECTED (, ,)	D
Cause	The upper side of the blue flame cannot be detected.	
Action	Clean the lens as required and execute the function for blue flame detection again. Ask Mazak service center to take appropriate measures (checking the lens position for appropriateness, adjusting the voltage for the blue flame sensor, adjusting the height of the plate, etc.) if the repeated execution should cause the alarm again in spite of the cleaning.	

No.	Message	Clearing procedure
1251	LOWER BLUE FLAME ISN'T DETECTED (, ,)	D
Cause	The lower side of the blue flame cannot be detected.	
Action	Clean the lens as required and execute the function for blue flame detection again. Ask Mazak service center to take appropriate measures (checking the lens position for appropriateness, adjusting the voltage for the blue flame sensor, adjusting the height of the plate, changing the lasing conditions, etc.) if the repeated execution should cause the alarm again in spite of the cleaning.	
1252	BLUE FLAME IS NOT DETECTED (, ,)	D
Cause	The blue flame cannot be correctly detected.	
Action	Clean the lens as required and execute the function for blue flame detection again. Ask Mazak service center to take appropriate measures (checking the lens position for appropriateness, adjusting the voltage for the blue flame sensor, adjusting the height of the plate, changing the lasing conditions, etc.) if the repeated execution should cause the alarm again in spite of the cleaning.	
1253	FOCUS IS OUT OF RANGE (, ,)	D
Cause	The focus obtained by the blue flame detection is outside the allowable range.	
Action	Clean the lens as required and execute the function for blue flame detection again. Ask Mazak service center to take appropriate measures (checking the lens position for appropriateness, adjusting the voltage for the blue flame sensor, adjusting the height of the plate, changing the lasing conditions, etc.) if the repeated execution should cause the alarm again in spite of the cleaning.	
1254	AUTO FOCUS DIST. OUT OF RANGE (, ,)	D
Cause	The reference distance for the automatic focusing function (#998) is outside the setting range.	
Action	Correct the #998 setting. Setting range for the automatic focusing reference distance (#998) is as follows: $-93 \leq \#998 \leq -89$ [for a torch without Servo Focus functions], or $-28 \leq \#998 \leq -24$ [for a torch with Servo Focus functions].	
1255	FOCUS LENGTH IS OUT OF RANGE (, ,)	D
Cause	The focal length (#999) is outside the setting range.	
Action	Correct the #999 setting. Setting range for the focal length (#999) is as follows: $-15.5 \leq \#999 \leq 0$ [for a torch without Servo Focus functions], or $-19 \leq \#999 \leq 0$ [for a torch with Servo Focus functions].	
1280	INTELLIGENT BOX AREA (, ,)	D
Cause	A command of G22 is given with the cutting head remaining within the special area of the intelligent box.	
Action	Move the cutting head out of the special area of the intelligent box beforehand. The special area of the intelligent box is determined as follows by the parameters concerned: **J440**: Intelligent box area X (X > J440) **J441**: Intelligent box area Y (Y < J441) **J442**: Intelligent box area Z (Z < J442)	

5 AUTOMATIC FOCUSING FUNCTION (WITH SERVO FOCUS TORCH)

5-1 Outline

Use of a Servo Focus torch allows the focal point to be changed quickly and accurately.
This function is only applicable when the focal length is set correctly by manual measurement or using the function of blue flame detection (G22B1).

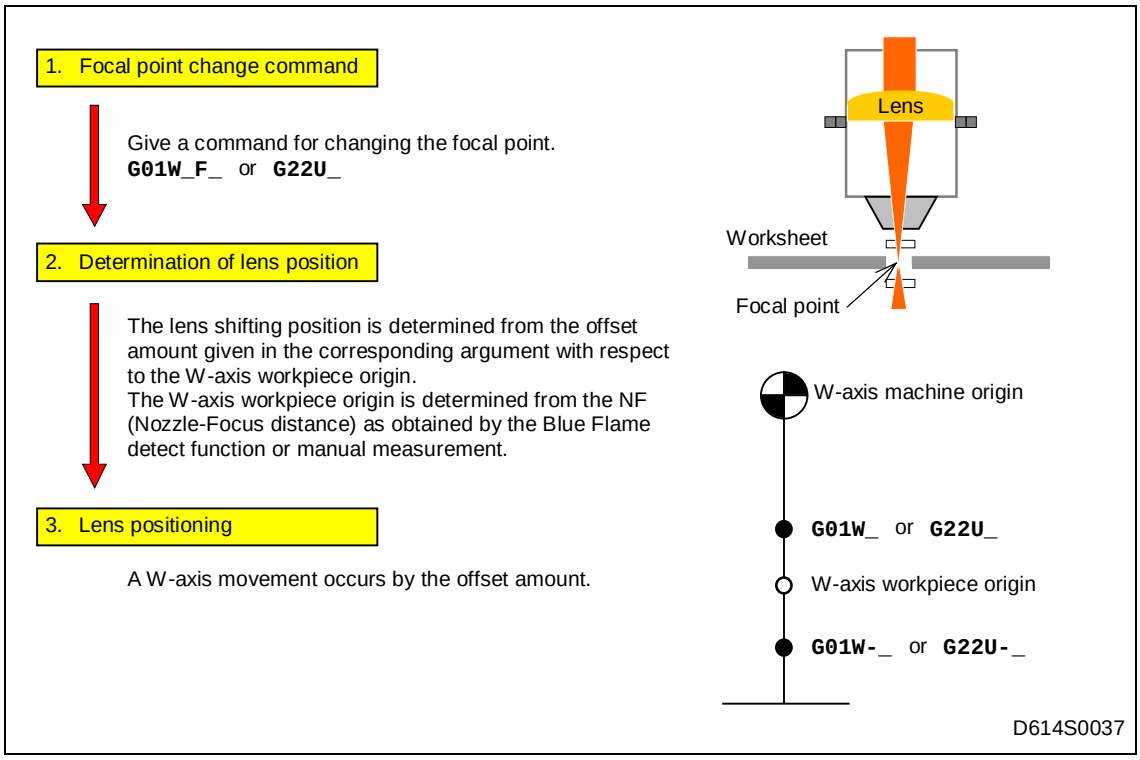

1. Focal point change command
Give a command for changing the focal point.
G01W_F_ or G22U_
2. Determination of lens position
The lens shifting position is determined from the offset amount given in the corresponding argument with respect to the W-axis workpiece origin.
The W-axis workpiece origin is determined from the NF (Nozzle-Focus distance) as obtained by the Blue Flame detect function or manual measurement.
3. Lens positioning
A W-axis movement occurs by the offset amount.
Lens
Worksheet
Focal point
W-axis machine origin
G01W_ or G22U_
W-axis workpiece origin
G01W-_ or G22U-_
D614S0037

Fig. 5-1 Outline of the automatic focusing function (with Servo Focus torch)

The main advantageous effects of this function are as follows.

Item	Torch with Servo Focus functions
Focal point range enlarged	Range: 24 mm
Quick focal point change	Servo control (of the W-axis) allows quick focal point change 'on the spot'.
Reduction in piercing time	Quick change in focal point from piercing to cutting, and vice versa. Piercing and cutting can be performed successively. Consequently, the total length of non-cutting axis movements is drastically reduced for each worksheet. <Programming example> **G22T7.5Z2.0W0** **G01W-13.F3000** Piercing **G01W-1.F3000** Cutting **G01W-13.F3000** Piercing **G01W-1.F3000** Cutting

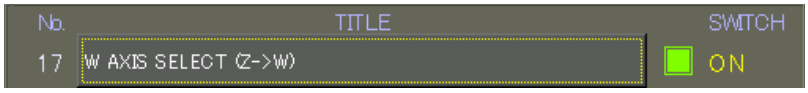
5-2 Operating Instructions

This section gives instructions for operating a Servo Focus torch.

5-2-1 Initial adjustment

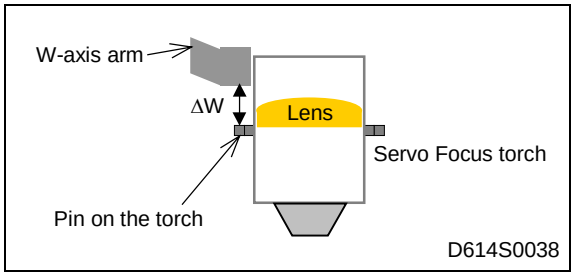
The initial adjustment for using a Servo Focus torch on the laser machine is: measuring the distance between the arm of the W-axis and the pin on the torch, and setting the corresponding coordinate on the **TOOL DATA** screen. Follow the procedure below to perform the initial adjustment.

(1) On the **SWITCH** screen set the **W AXIS SELECT** switch to ON.



Note: W-axis is the controlled axis added for changing the focal point on the Servo Focus torch.
It should be noticed here that setting the **W AXIS SELECT** switch to ON changes the functions of the Z-axis operation switches on the operating panel totally (in all manual operation modes) for W-axis operation.

(2) By operating the pulse handle, carry out a W-axis movement in the negative direction to bring the W-axis arm into contact with the pin on the torch.



(3) Register the W-axis coordinate (ΔW) obtained in Step (2) above on the **TOOL DATA** screen as the **Z** value on the **Auto Focus** line.

- Move the cursor onto the **Z** item on the **Auto Focus** line and select the **[MODIFY]** or **[TEACH]** menu item.

D614SA0039E

Note: If the registered coordinate is out of the range of –1 ± 2 mm, an automatic focusing command (G22U_) will lead to an alarm (No. 1254). In this case readjustments for the W-axis origin are necessary.

(4) Finally, return the **W AXIS SELECT** switch to OFF on the **SWITCH** screen.

5-2-2 Programming

Programming details for using the Servo Focus torch are as follows.

Note: The setting range of focal point offset amount depends upon the specifications of the machine.

1. Using G01

A. Programming format

G01W_F_

Address	Contents	Unit	Setting range
W	Focal point offset amount	mm	–19.0 to 5.0
		in	–0.748 to 0.196
F	W-axis motion speed	mm/min	0 to 3000
		IPM	0 to 118

B. Program example

```
G22T7.5Z2.0W0 ..... Tool selection
G01W-13.F3000 ..... Focal point change
M98P***       ..... Piercing
G01W-1.F3000  ..... Focal point change
M98P***       ..... Cutting
G01W-13.F3000 ..... Focal point change
M98P***       ..... Piercing
G01W-1.F3000  ..... Focal point change
M98P***       ..... Cutting
M30
```

2. Using G22

A. Programming format

G22U_

Address	Contents	Unit	Setting range
U	Focal point offset amount	mm	–19.0 to 5.0
		in	–0.748 to 0.196

B. Program example

```
G22T7.5Z2.0W0 ..... Tool selection
G22U-13.      ..... Focal point change
M98P***       ..... Piercing
G22U-1.       ..... Focal point change
M98P***       ..... Cutting
G22U-13.      ..... Focal point change
M98P***       ..... Piercing
G22U-1.       ..... Focal point change
M98P***       ..... Cutting
M30
```

6 INTELLIGENT MONITORING SYSTEM (IMS)

The functions of the Intelligent Monitoring System (hereinafter referred to as the IMS) can be broadly divided into the following three. This chapter outlines each function and explains how to use it.

1. Piercing detection function
2. Plasma detection function
3. Burning detection function

6-1 Piercing Detection Function

6-1-1 Outline

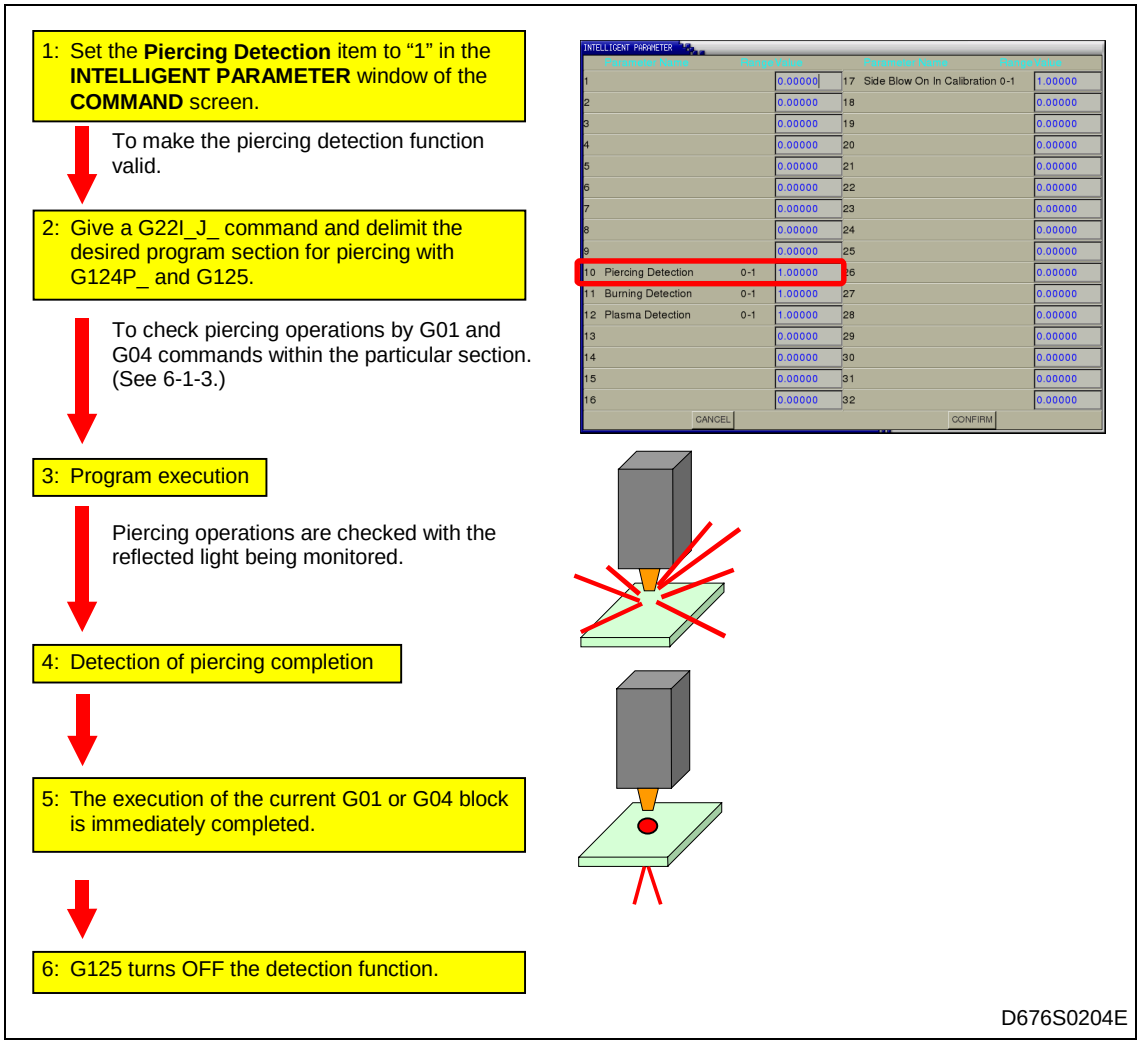

1: Set the **Piercing Detection** item to "1" in the **INTELLIGENT PARAMETER** window of the **COMMAND** screen.
To make the piercing detection function valid.
2: Give a G22I_J_ command and delimit the desired program section for piercing with G124P_ and G125.
To check piercing operations by G01 and G04 commands within the particular section. (See 6-1-3.)
3: Program execution
Piercing operations are checked with the reflected light being monitored.
4: Detection of piercing completion
5: The execution of the current G01 or G04 block is immediately completed.
6: G125 turns OFF the detection function.
INTELLIGENT PARAMETER
10 Piercing Detection 0-1 1.00000
11 Burning Detection 0-1 1.00000
12 Plasma Detection 0-1 1.00000
17 Side Blow On In Calibration 0-1 1.00000
CANCEL
CONFIRM
D676S0204E

Fig. 6-1 Outline of the piercing detection function

1. Applications

The function is provided with a sensor for the reflected light. When the sensor detects the disappearance, or significant reduction in intensity, of the reflected light, the function judges that the piercing is completed (a clearance hole is produced), and skips the remaining dwell time to reduce the piercing time.

- The piercing time can vary depending on the condition of the material piece and the machining conditions. This function absorbs the variation so as to finish the piercing operation in the shortest possible time.
- In the standard machining conditions the piercing dwell time is usually set to have a margin. The excess time can be skipped by this function when a piercing has been completed before the expiration of the programmed dwell time.

Note 1: The purpose of this function is to detect completion of piercing (piercing detection function), but not to detect that a piercing has failed (piercing failure detection function). Consequently, the next command will be executed as usual when the specified dwell time has passed even before completion of piercing. As blow-up may occur in such a case, the dwell time should be set somewhat longer than necessary.

Note 2: The piercing time and the piercing detection timing vary depending on the material, machining conditions, nozzle size, lens used and other conditions of the machine. Their variations are at most 1 second after the completion of piercing, and a time error may occur within this range. The time required for the processing upon piercing detection is 0.5 second or more.

Note 3: The sensor cannot detect the completion of piercing with an accuracy of 100%. Depending on the conditions, it may fail to detect the completion of piercing and the dwell command will be executed to the end. Therefore, do not set an unnecessarily long dwell time.

Note 4: The effect of the sensor is reduced during quick piercing, because quick piercing using a Servo Focus torch requires less time than step piercing.

Note 5: If the components of the optical path have become dirty because of a break of the lens or for any other reason, ask our service engineers for maintenance. When the sensor is fouled, this function does not work properly.

Note 6: This function receives scattered light with a sensor. Contamination of the convergent lens will influence the intensity of the light received. Therefore, the maintenance of the lens is necessary for proper operation of this function.

Note 7: This function does not work properly for a black lens.

2. Specifications

- Plate material: Mild steel, Stainless steel, Aluminum
- Plate thickness: 6 mm (0.237 in) or more

  Note: The maximum permissible plate thickness depends upon the machine specifications.
- Torch: Use a standard high-speed machining torch (Servo Focus torch).
- Pulse frequency for piercing: 20 Hz and above
- Do not fail to specify the material type and the plate thickness (with G22 I_J_).
- The sensitivity of the IMS sensor concerned is preset in the CNC, but can be modified as required.
- When a double nozzle is used, the sensitivity is automatically adjusted by the CNC.

The threshold for piercing detection varies according to the piecing type and the nozzle type. The four combination patterns in question are as follows.

1. Step piercing + Single nozzle
2. Step piercing + Double nozzle
3. Quick piercing + Single nozzle
4. Quick piercing + Double nozzle

The piercing type needs to be specified with a G124P_ command described later.

The nozzle type is automatically identified from the settings concerned on the **Tool Data** screen.

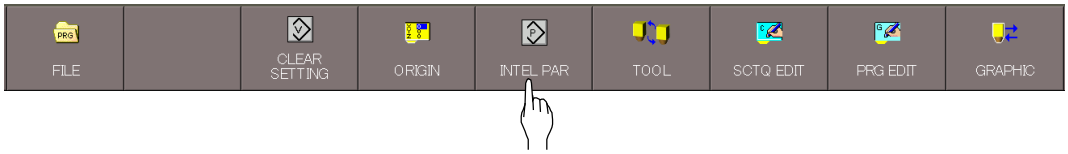
6-1-2 Operating instructions

Follow the procedure below to use the piercing detection function.

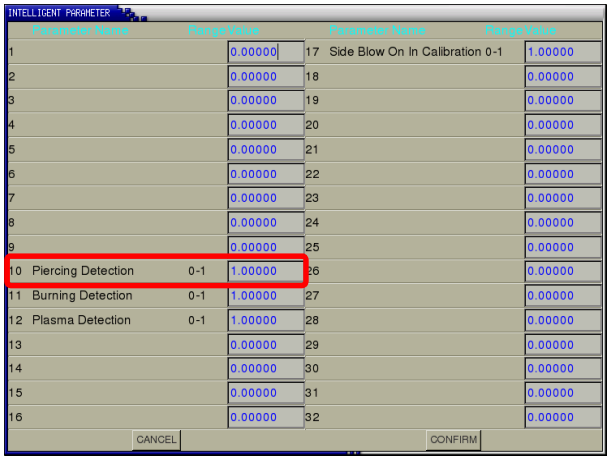
(1) Open the **INTELLIGENT PARAMETER** window from the **COMMAND** screen to make this function valid (by setting “1”).

1) Call up the **COMMAND** screen.

2) Select the **[INTEL PAR]** menu item.



➔ The **INTELLIGENT PARAMETER** window appears.



3) Set “1” in the **Piercing Detection** box and press the **[CONFIRM]** button.
(This setting item is linked with the Intelligent user parameter **L090**.)

➔ The function becomes valid.

(2) Enter “G22I_J_” at the head of the program, delimit a desired program section for piercing with G124P_ and G125, and start automatic operation.

➔ Piercing operations undergo a checking for piercing completion. The checking function is selectively activated within the program section between G124P_ and G125.

6-1-3 Programming

1. Setting the piercing detection conditions

Give a command of **G22I_J_** to specify the material and plate thickness, and the piercing detection conditions appropriate for the material and plate thickness are automatically selected.

A. Programming format

G22 I (Material) **J** (Plate thickness)

B. Detailed description

Address	Contents	Unit	Setting range	Remarks	
I	Material	—	0, 1, 2, 3	Omission	Piercing detection Invalid.
				0	Piercing detection Invalid.
				1	Mild steel. Piercing detection **Valid**.
				2	Stainless steel. Piercing detection **Valid**.
				3	Aluminum. Piercing detection **Valid**.
J	Plate thickness	mm	6 -	The plate thickness must be 6 mm or more.	
		in	0.237 -	The plate thickness must be 0.237 in or more.	

- The piercing detection is not made valid if a material code (argument I) other than the above is specified.
- The maximum permissible plate thickness depends on the machine specifications.

2. Turning ON/OFF the piercing detection

The piercing detection function (the conditions for which should be set by a block of **G22I_J_**) is to be selectively actuated for a program section delimited with G124P_ and G125.
The execution of G01 and G04 commands within the section undergoes the checking and is immediately terminated upon detection of piercing completion.

A. Programming format

G124P_: Piercing detection is turned ON.
(G124P1: Step piercing, G124P2: Quick piercing)

G125: Piercing detection is turned OFF.

B. Detailed description

1. G124 and G125 are modal functions. The one remains valid until it is replaced by the other.
2. The initial state (upon switching-on or resetting) is of G125.
3. In the mode of G125 the piercing detection function is invalid and no detection of piercing is done. Use the code G124 to make the piercing detection function valid again.
4. Independently of whether tracing is ON or OFF, the piercing detection function works in the mode of G124.

C. Example of use

1. For step piercing (G124P1)

```
G22I1J10          (Piercing detection conditions are set.)
G92X0.Y0.
G124P1            (Piercing detection is turned ON.)
M98P***           (Setting the piercing conditions)
G04X5.            (Dwell with G04)..... To be skipped.
M98P**            (Setting the piercing conditions)
G04X10.           (Dwell with G04)..... To be skipped.
G125              (Piercing detection is turned OFF.)
M98P***           (Setting the lead-in conditions)
M98P***           (Setting the cutting conditions)
G01Y25.
X-50.
Y-50.
X50.
Y25.
M98P***           (Machining end processing)
M30
```

Piercing detection function works for G04 commands.

2. For quick piercing (G124P2)

```
G22I1J10          (Piercing detection conditions are set.)
G92X0.Y0.
G124P2            (Piercing detection is turned ON.)
M98P***           (Setting the piercing conditions)
G01W-10.F300      (Motion with G01W) ..... To be skipped.
G04X5.            (Dwell with G04)..... To be skipped.
G125              (Piercing detection is turned OFF.)
M98P***           (Setting the lead-in conditions)
G91G01X5.
M98P***           (Setting the cutting conditions)
G01Y25.
X-50.
Y-50.
X50.
Y25.
M98P***           (Machining end processing)
M30
```

Piercing detection function works for G01W and G04 commands.

6-1-4 Checking the piercing detection status

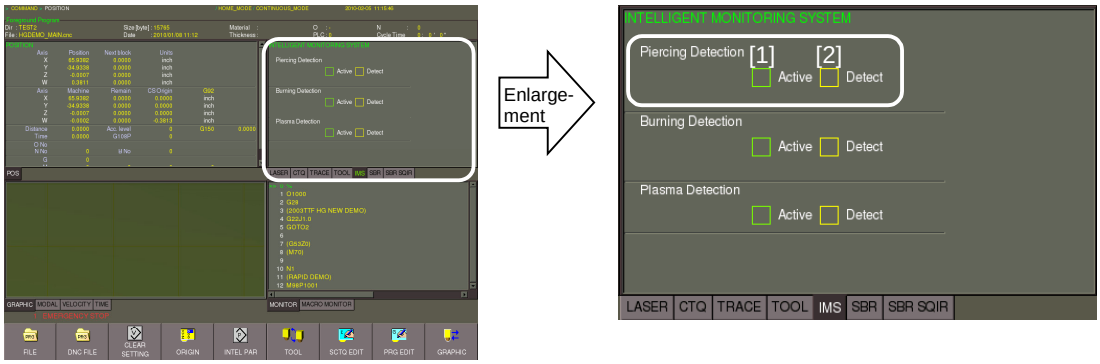
The piercing detection status can be checked in the IMS window opened in the upper right column of the **Command** screen.

[1] **Active**

The LED is lit while an analysis is being made to determine whether piercing is completed.

[2] **Detect**

The LED lights up at the instant when the completion of piercing is detected.



COMMAND screen IMS window

6-1-5 Setting the sensitivity

The sensitivity for the piercing detection function refers to the response level for the photosensor. The recommended sensitivity values preset with parameters can be modified as required to meet the particular needs.

To adjust the sensitivity, change the threshold for piercing detection. Piercing is judged to be completed when the intensity of the light reflected during piercing falls below the threshold in question.

Here are the relationships between threshold and sensitivity for piercing detection.

- Increase in piercing detection threshold = Increase in piercing detection sensitivity = Increase in detection responsiveness
- Decrease in piercing detection threshold = Decrease in piercing detection sensitivity = Decrease in detection responsiveness

Different values of piercing detection threshold are provided according to the piecing type (step or quick piercing) and the nozzle type (single or double nozzle), as shown in the following table of the parameters concerned. Adjustment should be performed appropriately for each combination.

	Step piercing		Quick piercing		Unit	Setting range	Remarks
	Single nozzle	Double nozzle	Single nozzle	Double nozzle			
Piercing detection threshold	**L224**	**L234**	**L244**	**L254**	—	0 to 1	Standard range: 0.1 to 0.2

Note 1: Modify the threshold normally within the standard range shown above. Too high a threshold setting could cause false detection of piercing completion and thus allow the cutting operation to be started prematurely, resulting in a machining failure.

Note 2: The default settings are changed by the CAM according to the conditions.

6-2 Plasma Detection Function

6-2-1 Outline

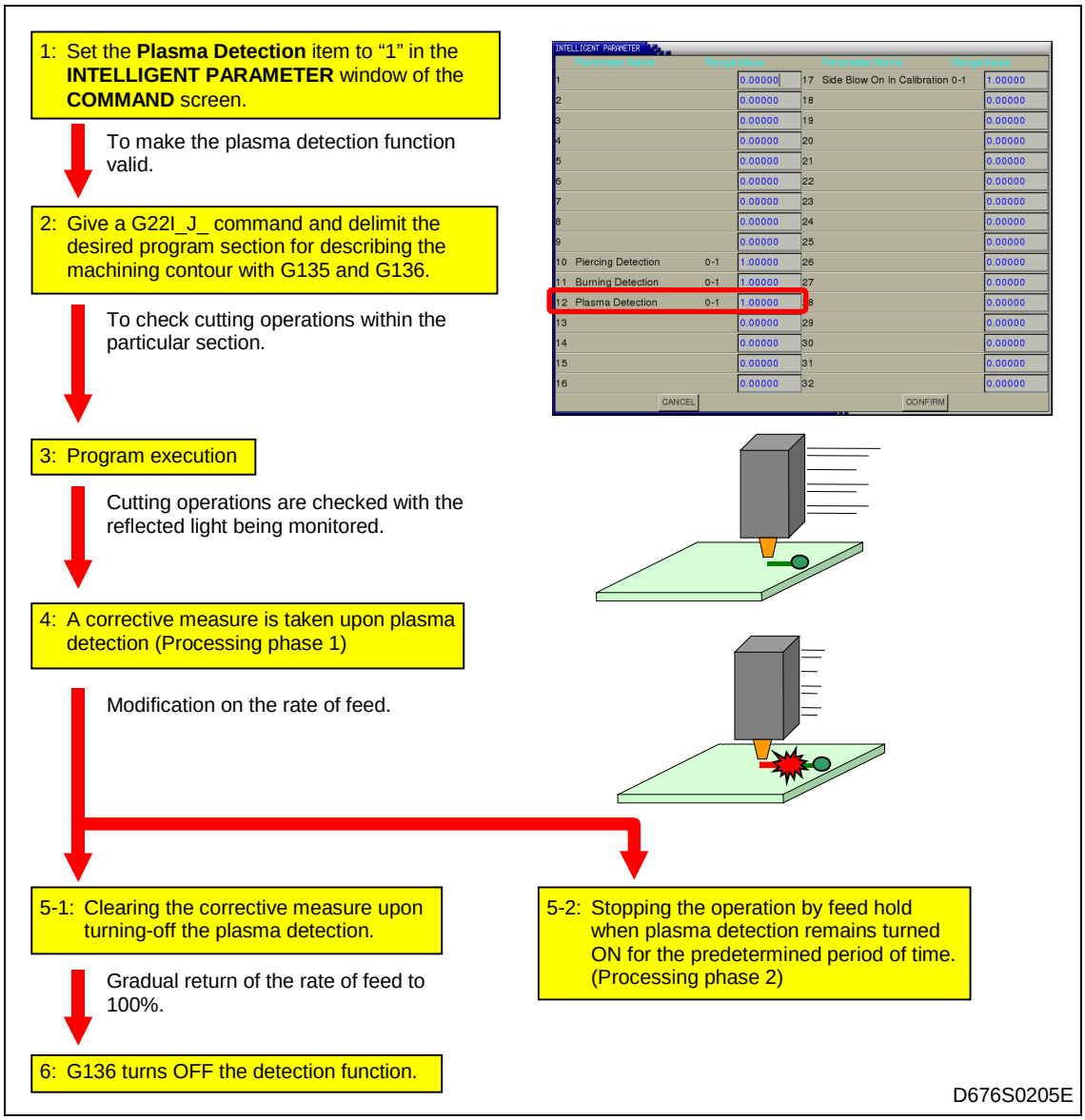

1: Set the **Plasma Detection** item to "1" in the **INTELLIGENT PARAMETER** window of the **COMMAND** screen.
To make the plasma detection function valid.
2: Give a G22I_J_ command and delimit the desired program section for describing the machining contour with G135 and G136.
To check cutting operations within the particular section.
3: Program execution
Cutting operations are checked with the reflected light being monitored.
4: A corrective measure is taken upon plasma detection (Processing phase 1)
Modification on the rate of feed.
5-1: Clearing the corrective measure upon turning-off the plasma detection.
Gradual return of the rate of feed to 100%.
6: G136 turns OFF the detection function.
5-2: Stopping the operation by feed hold when plasma detection remains turned ON for the predetermined period of time. (Processing phase 2)
INTELLIGENT PARAMETER
10 Piercing Detection 0-1 1.00000
11 Burning Detection 0-1 1.00000
12 Plasma Detection 0-1 1.00000
17 Side Blow On In Calibration 0-1 1.00000
CANCEL
CONFIRM
D676S0205E

Fig. 6-2 Outline of the plasma detection function

1. Applications

Upon detection of plasma generated at corners of the machining contour, for example, during machining of stainless steel or aluminum material, this function automatically provides corrective measures (lowering the rate of feed to the preset level and then gradually returning it to 100%) to reduce machining defects. If, however, the corrective measures cannot produce improvement in machining state within a predetermined period of time, the machine will enter either the feed hold state with an alarm (**CUTTING FAILURE**) displayed on the screen, or the tracing retrial mode (on condition that the tracing retry function is currently set ON).

- It reduces machining defects at acute corners or in a section of complicated geometry.
- It reduces machining defects after piercing.
- It reduces machining defects after a tracing retry.

- The plasma detection function can be turned ON and OFF entirely or partially for each machining program.

Note 1: In portions where the sensor was activated and in portions where corrective measures were taken, the quality of cut surfaces is degraded.

Note 2: Cutting failures that occur as a result of abnormal cutting conditions cannot be detected or corrected. Check the cutting conditions and the condition of the machine beforehand for appropriateness. This function is designed to deal with machining defects due to change in material properties, an abrupt turn in the tool path, etc.

Note 3: This function receives scattered light with a sensor. Contamination of the convergent lens will influence the intensity of the light received. Therefore, the maintenance of the lens is necessary for proper operation of this function.

Note 4: This function does not work properly for a black lens.

Note 5: Plasma can be detected for a pulse frequency of 501 Hz or higher. Therefore, disable the plasma detection function for cutting operations with a pulse frequency of 500 Hz or lower.

2. Specifications

- Plate material: Stainless steel, Aluminum
- Plate thickness: 6 mm (0.237 in) or more
  (The maximum permissible plate thickness depends upon the machine specifications.)
- Torch: Use a standard high-speed machining torch (Servo Focus torch).
- Do not fail to specify the material type and the plate thickness (with G22 I_J_); otherwise this function cannot be made valid.
- The sensitivity of the IMS sensor concerned is preset in the CNC, but can be modified as required.
- When a double nozzle is used, the sensitivity is automatically adjusted by the CNC.

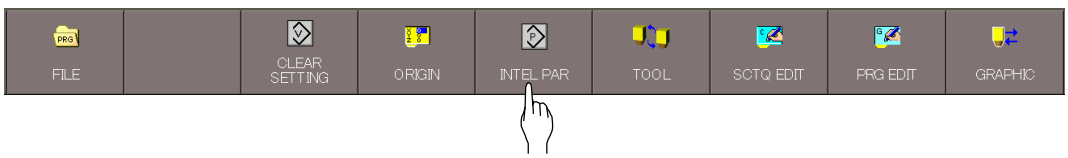
6-2-2 Operating instructions

Follow the procedure below to use the plasma detection function.

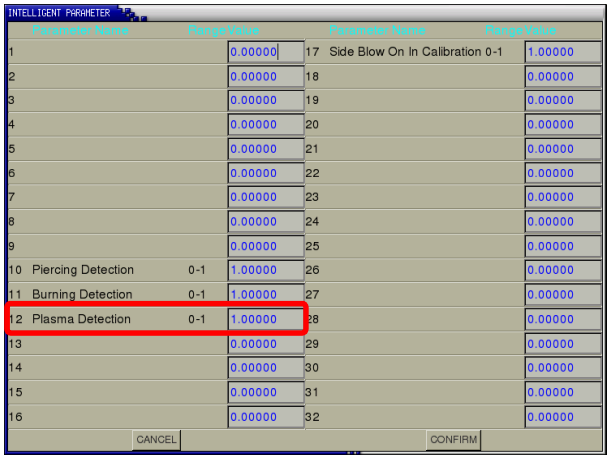
(1) Open the **INTELLIGENT PARAMETER** window from the **COMMAND** screen to make this function valid (by setting “1”).

1) Call up the **COMMAND** screen.

2) Select the **[INTEL PAR]** menu item.



➔ The **INTELLIGENT PARAMETER** window appears.



3) Set “1” in the **Plasam Detection** box and press the **[CONFIRM]** button.
(This setting item is linked with the Intelligent user parameter **L092**.)

➔ The function becomes valid.

(2) Enter “G22I_J_” at the head of the program, delimit a desired program section with G135 and G136, and start automatic operation.

➔ Cutting operations undergo a checking for plasma generation. The checking function is selectively activated within the program section between G135 and G136.

6-2-3 Programming

1. Setting the plasma detection conditions

Give a command of **G22I_J_** to specify the material and plate thickness, and the plasma detection conditions appropriate for the material and plate thickness are automatically selected and used in processing upon detection of plasma.

A. Programming format

G22 I (Material) **J** (Plate thickness)

B. Detailed description

Address	Contents	Unit	Setting range	Remarks	
I	Material	—	0, 2, 3	Omission	Plasma detection Invalid.
				0	Plasma detection Invalid.
				2	Stainless steel. Plasma detection **Valid**.
				3	Aluminum. Plasma detection **Valid**.
J	Plate thickness	mm	6 -	The plate thickness must be 6 mm or more.	
		in	0.237 -	The plate thickness must be 0.237 in or more.	

- The plasma detection is not made valid if a material code (argument I) other than the above is specified.
- The maximum permissible plate thickness depends on the machine specifications.

2. Turning ON/OFF the plasma detection

The plasma detection function (the conditions for which should be set by a block of **G22I_J_**) is to be selectively actuated for a contour-describing program section delimited with G135 and G136. The execution of cutting commands within the section undergoes the checking with the reflected light being monitored and corrective measures (e.g. feed hold) are taken upon detection of plasma.

A. Programming format

G135: Plasma detection is turned ON.

G136: Plasma detection is turned OFF.

B. Detailed description

1. G135 and G136 are modal functions. The one remains valid until it is replaced by the other.
2. The initial state (upon switching-on or resetting) is of G136.
3. In the mode of G136 the plasma detection function is invalid and no modification is done on the rate of feed, nor is an alarm caused, even if plasma is detected. Use the code G135 to make the plasma detection function valid again.
4. Independently of whether tracing is ON or OFF, the plasma detection function works in the mode of G135.

C. Example of use

```
G22I2J10        (Plasma detection conditions are set.)
G92X0.Y0.
M98P***         (Piercing)
M98P***         (Setting the lead-in conditions)
G91G01X5.
G135            (Plasma detection is turned ON.)
M98P***         (Setting the cutting conditions)
G01Y25.
X-50.
Y-50.
X50.
Y25.
G136            (Plasma detection is turned OFF.)
M98P***         (Machining end processing)
M30
```

Piercing detection function works within this section.

6-2-4 Checking the plasma detection status

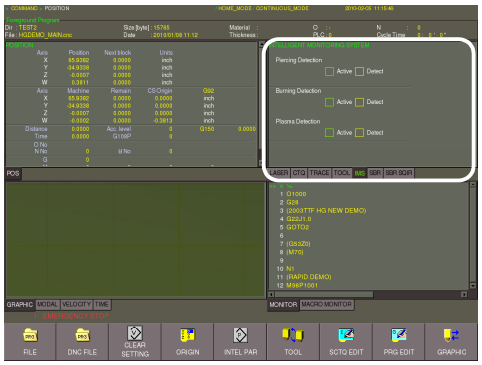
The plasma detection status can be checked in the IMS window opened in the upper right column of the **Command** screen.

[1] **Active**

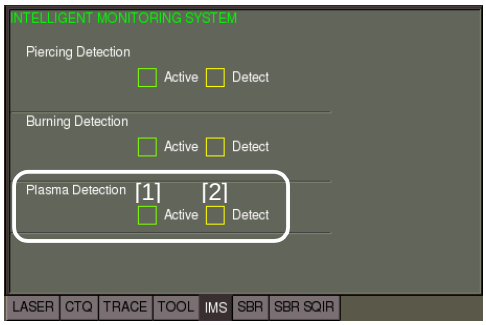
The LED is lit while an analysis is being made to determine whether plasma is generated.

[2] **Detect**

The LED lights up at the instant when plasma is detected.



Enlarge-ment



COMMAND screen

IMS window

6-2-5 Setting the sensitivity

The sensitivity for the plasma detection function refers to the response level for the photosensor. The recommended sensitivity values preset with parameters can be modified as required to meet the particular needs.

To adjust the sensitivity, change the response level for plasma detection. Plasma is judged to be generated when the intensity of the light reflected during cutting oversteps the response level in question.

Here are the relationships between response level and sensitivity for plasma detection.

- Increase in response level for plasma detection = Decrease in plasma detection sensitivity = Decrease in detection responsiveness
- Decrease in response level for plasma detection = Increase in plasma detection sensitivity = Increase in detection responsiveness

Different values of response level for plasma detection are provided according to the nozzle size (hole diameter), as shown in the following table of the parameters concerned. Adjustment should be performed appropriately for each nozzle size.

Parameter No.	Contents		Unit	Setting range	Remarks
L430	Response level for plasma detection, for a nozzle with a hole diameter of	1.0 mm	—	0 to 10	Standard range: 0.5 to 2
L431		1.2 mm			
L432		1.5 mm			
L433		2.0 mm			
L434		2.5 mm			
L435		3.0 mm			
L436		3.5 mm			
L437		4.0 mm			

Note 1: Modify the response level normally within the standard range shown above. Too low a response level setting could cause false detection of plasma even in a normal flow of cutting operation.

Note 2: The default settings are changed by the CAM according to the conditions.

6-3 Burning Detection Function

6-3-1 Outline

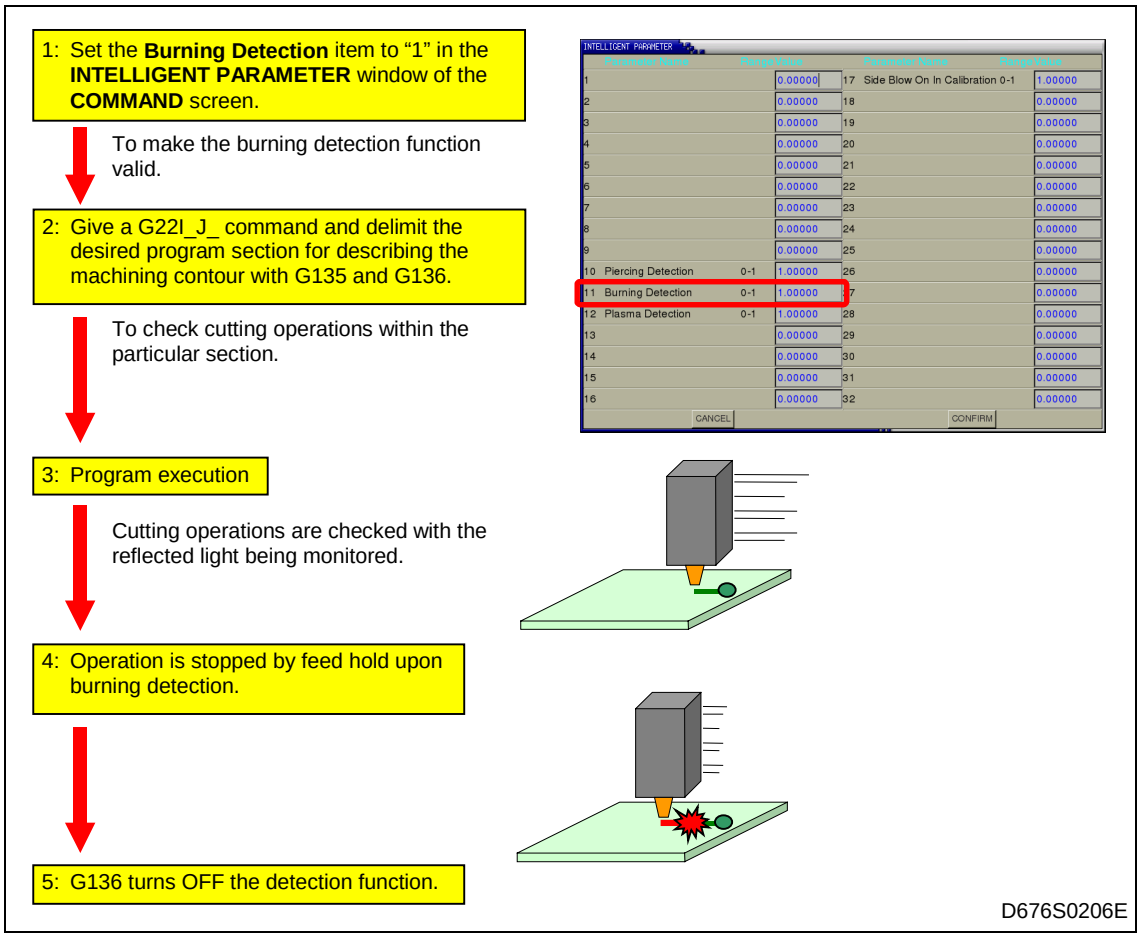

1: Set the **Burning Detection** item to “1” in the **INTELLIGENT PARAMETER** window of the **COMMAND** screen.
To make the burning detection function valid.
2: Give a G22I_J_ command and delimit the desired program section for describing the machining contour with G135 and G136.
To check cutting operations within the particular section.
3: Program execution
Cutting operations are checked with the reflected light being monitored.
4: Operation is stopped by feed hold upon burning detection.
5: G136 turns OFF the detection function.
INTELLIGENT PARAMETER
17 Side Blow On In Calibration 0-1
10 Piercing Detection 0-1
11 Burning Detection 0-1
12 Plasma Detection 0-1
CANCEL
CONFIRM
D676S0206E

Fig. 6-3 Outline of the burning detection function

1. Applications

Upon detection of burning at corners of the machining contour, for example, during machining of mild steel material, this function set the machine either into the feed hold state with an alarm (**CUTTING FAILURE**) displayed on the screen, or the tracing retrial mode (on condition that the tracing retry function is currently set ON).

- Detection of machining defects reduces waste of material.
- The burning detection function can be turned ON and OFF entirely or partially for each machining program.

Note 1: Portions where the sensor reacted remain unbroken without being cut off, or with sticking dross.

Note 2: The detection of burning will always cause the operation to be stopped with an alarm.

Note 3: Cutting failures that occur as a result of abnormal cutting conditions cannot be detected or corrected. Check the cutting conditions and the condition of the machine beforehand for appropriateness. This function is designed to deal with machining defects due to change in material properties, an abrupt turn in the tool path, etc.

Note 4: This function receives scattered light with a sensor. Contamination of the convergent lens will influence the intensity of the light received. Therefore, the maintenance of the lens is necessary for proper operation of this function.

Note 5: This function does not work properly for a black lens.

Note 6: Burning can be detected for a pulse frequency of 501 Hz or higher. Therefore, disable the burning detection function for cutting operations with a pulse frequency of 500 Hz or lower.

2. Specifications

- Plate material: Mild steel
- Plate thickness: 6 mm (0.237 in) or more
  (The maximum permissible plate thickness depends upon the machine specifications.)
- Torch: Use a standard high-speed machining torch (Servo Focus torch).
- Do not fail to specify the material type and the plate thickness (with G22 I_J_); otherwise this function cannot be made valid.
- The sensitivity of the IMS sensor concerned is preset in the CNC, but can be modified as required.
- When a double nozzle is used, the sensitivity is automatically adjusted by the CNC.

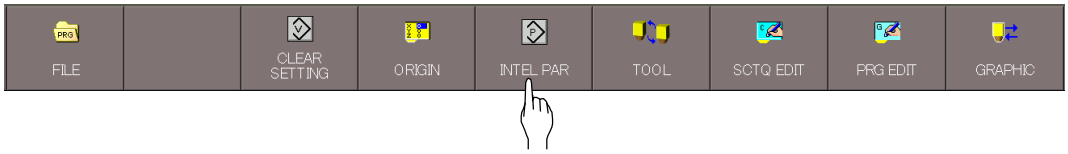
6-3-2 Operating instructions

Follow the procedure below to use the burning detection function.

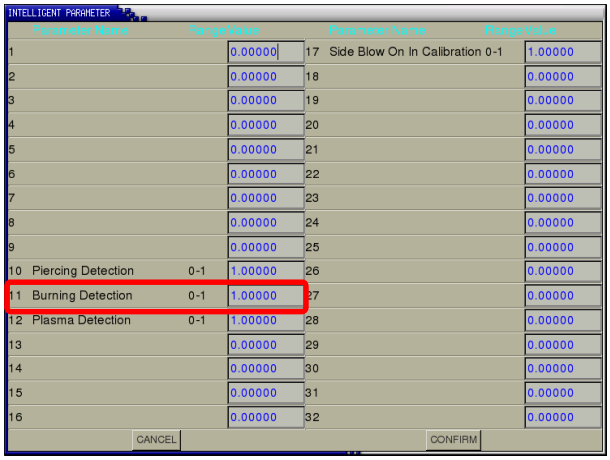
(1) Open the **INTELLIGENT PARAMETER** window from the **COMMAND** screen to make this function valid (by setting “1”).

1) Call up the **COMMAND** screen.

2) Select the **[INTEL PAR]** menu item.



➔ The **INTELLIGENT PARAMETER** window appears.



3) Set “1” in the **Burning Detection** box and press the **[CONFIRM]** button.
(This setting item is linked with the Intelligent user parameter **L091**.)

➔ The function becomes valid.

(2) Enter “G22I_J_” at the head of the program, delimit a desired program section with G135 and G136, and start automatic operation.

➔ Cutting operations undergo a checking for occurrence of burning. The checking function is selectively activated within the program section between G135 and G136.

6-3-3 Programming

1. Setting the burning detection conditions

Give a command of **G22I_J_** to specify the material and plate thickness, and the burning detection conditions appropriate for the material and plate thickness are automatically selected.

A. Programming format

G22 I (Material) **J** (Plate thickness)

B. Detailed description

Address	Contents	Unit	Setting range	Remarks	
I	Material	—	0, 1	Omission	Burning detection Invalid.
				0	Burning detection Invalid.
				1	Mild steel. Burning detection **Valid**.
J	Plate thickness	mm	6 -	The plate thickness must be 6 mm or more.	
		in	0.237 -	The plate thickness must be 0.237 in or more.	

- The burning detection is not made valid if a material code (argument I) other than the above is specified.
- The maximum permissible plate thickness depends on the machine specifications.

2. Turning ON/OFF the burning detection

The burning detection function (the conditions for which should be set by a block of **G22I_J_**) is to be selectively actuated for a contour-describing program section delimited with G135 and G136. The execution of cutting commands within the section undergoes the checking with the reflected light being monitored and the operation is stopped by heed hold upon detection of burning.

A. Programming format

G135: Burning detection is turned ON.

G136: Burning detection is turned OFF.

B. Detailed description

1. G135 and G136 are modal functions. The one remains valid until it is replaced by the other.
2. The initial state (upon switching-on or resetting) is of G136.
3. In the mode of G136 the burning detection function is invalid and no alarm is caused even if burning is detected. Use the code G135 to make the burning detection function valid again.
4. Independently of whether tracing is ON or OFF, the burning detection function works in the mode of G135.

C. Example of use

```
G22I1J10        (Burning detection conditions are set.)
G92X0.Y0.
M98P***         (Piercing)
M98P***         (Setting the lead-in conditions)
G91G01X5.
G135            (Burning detection is turned ON.)
M98P***         (Setting the cutting conditions)
G01Y25.
X-50.
Y-50.
X50.
Y25.
G136            (Burning detection is turned OFF.)
M98P***         (Machining end processing)
M30
```

Burning detection function works within this section.

6-3-4 Checking the burning detection status

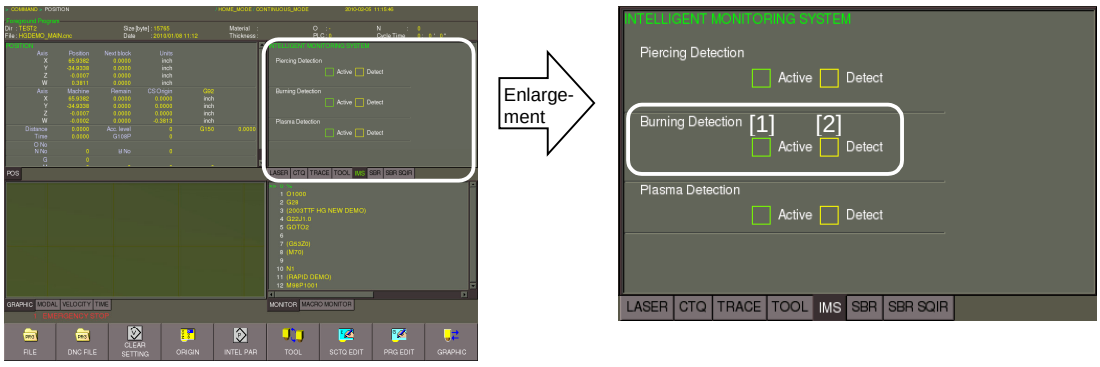
The burning detection status can be checked in the IMS window opened in the upper right column of the **Command** screen.

[2] **Active**

The LED is lit while an analysis is being made to determine whether burning is occurring.

[3] **Detect**

The LED lights up at the instant when burning is detected.



COMMAND screen

IMS window

6-3-5 Setting the sensitivity

The sensitivity for the burning detection function refers to the response level for the photosensor. The recommended sensitivity values preset with parameters can be modified as required to meet the particular needs.

To adjust the sensitivity, change the response level for burning detection. Burning is judged to be occurring when the intensity of the light reflected during cutting oversteps the response level in question.

Here are the relationships between response level and sensitivity for burning detection.

- Increase in response level for burning detection = Decrease in burning detection sensitivity = Decrease in detection responsiveness
- Decrease in response level for burning detection = Increase in burning detection sensitivity = Increase in detection responsiveness

Different values of response level for burning detection are provided according to the nozzle size (hole diameter), as shown in the following table of the parameters concerned. Adjustment should be performed appropriately for each nozzle size.

Parameter No.		Contents		Unit	Setting range	Remarks
Single nozzle	Double nozzle					
L330	**L380**	Response level for burning detection, for a nozzle with a hole diameter of	1.0 mm	—	0 to 10	Standard range: 0.5 to 2
L331	**L381**		1.2 mm			
L332	**L382**		1.5 mm			
L333	**L383**		2.0 mm			
L334	**L384**		2.5 mm			
L335	**L385**		3.0 mm			
L336	**L386**		3.5 mm			
L337	**L387**		4.0 mm			

Note 1: Modify the response level normally within the standard range shown above. Too low a response level setting could cause false detection of burning even in a normal flow of cutting operation.

Note 2: The default settings are changed by the CAM according to the conditions.